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RECENT STREET RAILWAY EXTENSION IN GLASGOW.

By J. A. STEWART.

THE street railway system of Glasgow in its management by the community and for the community has a wide prestige. Popular interest is consequently attracted to the developments now going on there for the enlargement and greater usefulness of the plant, in view of the demands already made upon it and the anticipated requirements caused by the opening of the Glasgow International Exhibition next May.

The progress of the street railway service in Glasgow makes interesting reading. It is only a matter of thirty years since the useful tramcar made its debut on the streets of the Scottish metropolis. This approved modern mode of transportation was inaugurated in 1870 by the granting of a lease for twenty-one years by the city to a private corporation for the purpose. This contract, it is to be noted, contained the thoughtful provision for municipal ownership if desired.

At the end of the lease there were but 31½ miles of street railway in operation, and the company in possession declined to accede to the moderate requests for a better grade of service and for increased facilities. The municipality then decided to take over the management of the cars into its own hands. This determination on the part of the city was not carried out without opposition from the company, who even went so far, it may be recalled, as to run a competing line of omnibuses for a time, an attempt which was quite unsuccessful in its aim to defeat municipal operation, the omnibuses having to be taken off in less than six months.

As the result of five years of municipal management, the community enjoys improved service; reduced fares; increase of wages and shorter hours of labor for street car employes; besides growth in traffic. In addition, the municipality has increased its paid-up capital, kept its lines in good repair, and made increasingly larger allowances for depreciation, sinking funds, renewal and reserve funds. Among the corporation's first moves were to cut off one source of revenue from disfiguring advertisements; to dress the drivers and conductors in neat uniforms and to reduce the hours of labor to ten hours daily. Special reduced fares for workingmen were established and 50 per cent. greater distance traversed for 2 cents. The following are the average distances that can now be traveled at the different fares:

Halfpenny fare, 0·58 mile; penny fare, 1·75 miles; three-halfpenny fare, 2·33 miles; two-penny fare, 3·47 miles; twopence halfpenny fare, 4·18 miles; three-penny fare, 5·34 miles.

The Glasgow lines radiate in twelve different routes, all of which pass through the heart of the city, a triangle bounded by three railway stations, the St. Enoch, Central and Queen Street stations. An increasingly large number of people is using the cars. This growing usefulness of the tramway service may be judged when it is stated that while the number of passengers carried by the Glasgow Tramway and Omnibus Company, Limited, during its last year of possession was about fifty million, the number carried by the corporation cars last year was nearly one hundred and fifty millions.

CAR BUILDING WORKS, GLASGOW CORPORATION TRAMWAYS.

This vast increase and the inevitable question of congestion have made electric traction a necessity. In November, 1897, the offer of the Westinghouse Company to provide the installation for a demonstration on the Springburn route was accepted. This involved, in addition to the equipment, permanent-way work by the Tramways Department, including the relaying of the track with a heavier section of rail, the laying of the ducts for the cables, and also the bonding of rails. The roadway under the railway bridge at St. Rollox had to be lowered 18 inches, so as to give a headway of 16 feet 6 inches, otherwise it would have been dangerous to use cars with top seats on this route.

The corporation had every reason to be satisfied with the results of the demonstration on the experimental route. The earnings averaged 28 cents per mile, and the working expenses 12·7 cents (6·38 d.) per car mile during the first year. The percentage of working expenses to receipts was 45·85 as compared with 73·89 for horse traction.

As has been stated, the fact that the Glasgow International Exhibition will open next May has expedited the extension of the street car service. The mileage will be increased from 84 at present to 121, including 34 miles of lines outside the city boundary. Next year Glasgow will bid adieu to horse traction forever. Electric traction will be adopted throughout the entire tramway system. The plans include the adoption of the overhead electric system, the underground being found too costly. Under the plans promulgated by the able general manager, Mr. John M. Young, the scheme for carrying out the change divides the whole system, embracing both track and depots, into four sections. The track conversion and the extensions at the Partick and Dalmarnock depots are covered by the first section. The first two sections together measure 25 miles of double track and comprise generally all the lines directly connected with the exhibition.

All the electric cars have been built at the department's workshops at Coplawhill, additional ground extending to 12,923 square yards having been taken,

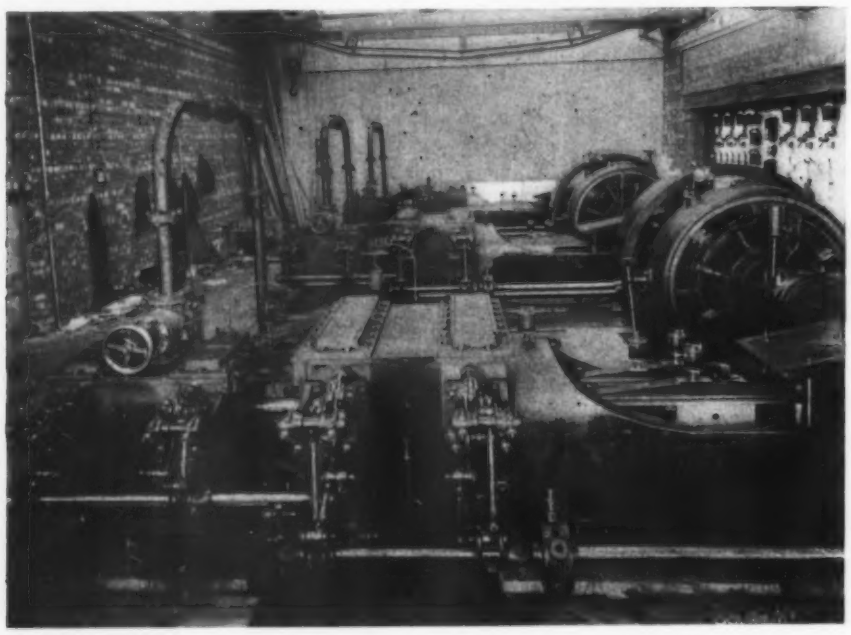
DOUBLE-DECKED CARS OF THE GLASGOW CORPORATION TRAMWAYS.

on which new carworks, sheds, etc., are being erected. It was decided by the corporation that the Tramways Department should erect their own power station. A very suitable plot of ground, 18,802 square yards in extent, has been secured for the purpose. It is close to the canal at Port Dundas and is connected with both the Caledonian and British Railways.

Mr. H. F. Parshall, M.Inst.C.E., M.I.E.E., of London, was made consulting engineer. His plan for generating and distributing the current provides for one main generating station and five sub-stations. Several of the existing depots will be utilized for the latter.

It is interesting to note that the electrical machinery installed is all made in America, partly by Westinghouse and partly by Brush. Two of the power engines come from Milwaukee and two are of English manufacture. The motors are provided by the Brill Company, and the equipment and controllers by Westinghouse. The rails used on the Glasgow roadways weigh 98 pounds per yard and are rolled in 60-foot lengths. Cast-iron chilled paving blocks are laid along each side of the rails in the busier thoroughfares to prevent excessive wear by the wheels of ordinary vehicles. The total cost of conversion from horse haulage to electric traction is estimated at $5,000,000.

A further reduction of fares is to go into effect at the beginning of the century. For one cent one may then ride three-quarters of a mile, and two cents worth will carry the passenger about three miles. Three consecutive one cent stages can be taken for two cents. It is worthy of note that in Glasgow every third person pays only a cent, and the average fare for the whole year is only three-quarters of a cent. The desire, as in America, is "to spread the population," and next year the Glasgow workman may ride six miles to his suburban home for the same fare the American pays for a single block. Apropos of the skillful and honest management, it is of interest to note the financial status of the tramways under civic control. The total amount of borrowing powers authorized was $4,500,000. Of the amounts borrowed from time to time, there has, up to



INTERIOR OF POWER STATION, GLASGOW TRAMWAY SYSTEM.

May, 1899, been repaid by means of the sinking fund $1,225,000. By the Glasgow Corporation Tramways Act, 1899, additional borrowing powers to the extent of $12,500,000 were conferred. The total amount of capital expenditure has been about $3,500,000. All the extra capital expenditure for extensions and additions to the plant has been met out of surplus revenue. The revenue of the department for the last financial year reached a grand total of $2,195,000, being an average of 23·2 cents per car mile. The working expenses averaged 16·8 cents per car mile, which left a balance of $665,000, or 6·4 cents per car mile, to meet all fixed charges.

[Continued from SUPPLEMENT, No. 1294, page 20737.]

CHEMICAL AND TECHNICAL EDUCATION IN THE UNITED STATES.*

By Prof. C. F. CHANDLER, Ph.D., M.D., LL.D., D.Sc., Oxon.

NICKEL PLATING.

NICKEL plating is a most useful application of electrolysis. It was invented by Isaac Adams, of Boston. Adams wondered why all attempts to plate nickel upon other metals had proved unsuccessful, and he began a careful investigation to ascertain the cause of the difficulties experienced. He soon found that the real difficulty was due to the presence of nitrates in the solution employed; nickel always appearing in commerce in the metallic form, it was natural when any one desired a solution to dissolve it in nitric acid, to precipitate the nitrate with carbonate of soda, and dissolve the carbonate of nickel in the proper acid for the solution desired. No one ever washed the carbonate of nickel with sufficient care to remove the last portions of the nitrate of soda; consequently all the nickel solutions previously experimented upon had contained nitrates, the presence of which Adams found to be fatal to successful nickel plating. This fact having been ascertained, successful nickel plating was the immediate result. Adams obtained a patent for this process which was afterward the subject of prolonged litigation. The novel proposition was presented to the court of a patent for not doing something, namely, for not permitting nitrates to find their way into the nickel solutions employed in nickel plating, and the court held that the exclusion of nitrates was an essential condition of successful nickel plating, and that a process involving this condition was just as patentable as a process involving any other special condition necessary for successful execution, and the patent was sustained.

ARTIFICIAL ILLUMINATION.

The subject of artificial illumination has developed wonderfully within my recollection. In my boyhood I lived in New Bedford, Massachusetts, the most important whaling port in the world at that time. More than 300 ships went out from that port and sailed the seas in search of whales, some going to the North Atlantic along the ice fields; others around the Cape of Good Hope to the Indian Ocean; and others again doubled Cape Horn and sailed up the Pacific through Behring Straits into the Arctic Seas, often being absent for more than three years from port. The business was very uncertain, but on the whole very profitable. If a ship made a first-rate voyage, it might bring back 4,000 barrels of sperm oil, worth over $200,000; the same quantity of whale oil would be worth over $100,000. At first, the whalebone of the "right whale" had so little value in the market that it was hardly worth while to bring it home; but as this substance became more and more useful in the arts, finally reaching a price of several dollars per pound, it became an important item in the catch. Each member of the ship's crew received a certain fraction of the catch as his share of the voyage. I remember the cooper's share was about one-fortieth of the catch. It was believed in those days that there was no other material that could ever compete with sperm oil, either as an illuminating agent or as a lubricator for fine machinery, such as cotton spindles, and my last recollection of the price of sperm oil in those days was $1.75 per wine gallon, which is the legal gallon in the United States. The whale oil sold for 80 cents a gallon. Artificial illumination with sperm oil, or even whale oil, was a pretty expensive luxury in those days, and various substitutes for these oils were successively introduced upon the market, particularly lard oil, rosin oil, spirits of turpentine, sold under the name "camphine," and a mixture of spirits of turpentine and alcohol, sold under the name of "burning fluid." The camphine and burning fluid, while much cheaper than the sperm oil, were very dangerous on account of their inflammability, and the escaping vapors which they evolved, and many accidents occurred in their use.

From the sperm oil, particularly that obtained from the head of the sperm whale, known as head matter, the spermaceti was extracted by chilling and pressing, and from that our best candles were manufactured. A small percentage of bleached beeswax was added to diminish the tendency to crystallization in the mould. Sometimes the spermaceti was poured into chilled candle moulds in order to produce a chill on the surface like the chill on a cast iron car wheel.

So profitable was this industry that New Bedford came to be the richest city of its size in the United States. Acres of casks of oil were stored in the city, and there were numerous oil refineries and candle works in operation.

COAL OIL.

In 1855 I saw for the first time in use in Berlin an oil called "photogen." On inquiring of Prof. Magnus, who lectured on industrial chemistry, as to the nature of this oil, I was informed that it was an artificial hydrocarbon oil obtained by distilling bituminous shales, and I subsequently visited a large establishment in Hamburg in process of erection for the manufacture of this "photogen oil" and paraffin from boghead coal imported from Torbane Hill, Scotland. On my return to New Bedford in the autumn of 1856 I informed my New Bedford friends of this new departure in artificial illumination, and found them extremely incredulous. They could not bring themselves to believe that any material could ever be found that could successfully compete with sperm oil.

As a matter of fact, however, there were several persons in America who had been engaged for some time in the manufacture of artificial hydrocarbon oils. Abraham Gessner had been at work since 1846 in the effort to produce oil economically by the destructive distillation of bituminous materials; and as early as 1850 Luther Atwood succeeded in making a fair quality of oil for lubricating purposes from coal tar. This was brought out by Samuel Downer of Boston and was put upon the market under the name of "coup oil," from the coup d'etat of the Emperor Louis Napoleon. In 1853 James Young, of Manchester, secured a patent in the United States for the manufacture of paraffin oil from bituminous coal.

The first company to engage in the manufacture of coal or shale oil in the United States was the North American Kerosene Gas Light Company, of New York, which was organized in the early part of 1854, working under the kerosene patents of John H. and George W. Austin. The works were erected opposite New York on Long Island, and an oil was put upon the market under the name of kerosene. Some time elapsed, however, before the oil came into use, for the reason that there were no suitable lamps available for burning it, and the invention of proper lamps occupied a year or two and delayed the introduction of this new oil.

In 1855 or 1856 a company was formed to manufacture oil and paraffin from the Breckinridge cannel coal of Kentucky. Another company manufactured oil from albertite found in Nova Scotia. This albertite is a very curious material. It has the vitreous appearance of certain asphaltums and is probably natural petroleum residuum. It yielded about one hundred gallons of oil to the ton. Another company was formed to manufacture oil from the grahamite of Ritchie County, West Virginia, another natural petroleum residuum, quite different from albertite; it had the appearance of a piece of ordinary coking coal, but was entirely soluble in spirits of turpentine, and in benzole, and yielded over 100 gallons of oil to the ton. This "coal oil" industry rapidly extended, and on January 1, 1860, there were forty coal oil factories on the Atlantic coast, 38 of which employed boghead coal imported from Scotland, while two employed albertite. Thus artificial illumination was revolutionized by the introduction of this artificial hydrocarbon oil, which soon came to be known as kerosene.

PETROLEUM.

While this industry was developing there were enterprising men in New Haven, Connecticut, who were considering the possibilities of petroleum. They consulted Prof. Benjamin Silliman, Jr., of Yale College, as to the possibility of securing petroleum, and he called their attention to the petroleum of Western Pennsylvania, which had been collected by the Indians in small quantities and distributed by the druggists as a cure for rheumatism under the name of "Seneca Oil." They visited Oil Creek in Venango County, Pa., and collected a few gallons of this oil by skimming it from the surface of ponds, and on April 16, 1855, Prof. Silliman made a report upon this petroleum. This report is published in full in The American Chemist, vol. 2, page 18, and is very interesting reading. Prof. Silliman points out the fact that this petroleum can be readily refined, with the production of a variety of oils suitable for many purposes, but particularly for burning in lamps, for lubricating, and for making candles. He made photometric experiments, and found that in a camphine lamp he obtained an eight candle-power flame with the consumption of 1¾ ounces of oil per hour. He mentions that at that time illuminating gas was selling in New York at $3.50 per 1,000 feet, that sperm oil cost $2.50 per gallon, colza oil $2, camphine 65 cents, and silvic oil from resin, 50 cents, and he pronounces the oil to be a most desirable material for artificial illumination. These gentlemen, Messrs. Eveleth, Bissell, and Reed, had organized in 1854 the Pennsylvania Rock Oil Company for the purpose of developing the natural petroleum of Western Pennsylvania. They had great difficulty in getting any considerable quantity of oil. They first skimmed the surface of the water with skimmers, subsequently ditches were dug in which water accumulated, and upon which the oil appeared as a scum, and instead of skimming it they took it up with blankets, which were held by the four corners and let down on the surface of the water; being already saturated with oil they absorbed no water, but took up whatever oil there was upon the surface. They were afterward wrung out over a tub. This was a pretty slow operation and the yield was extremely small, and it seemed as though the petroleum industry would never become a success.

To Col. G. L. Drake is due the credit of having made a success of this petroleum enterprise. He made diligent inquiry with regard to petroleum, and found that on two different occasions petroleum had flowed from salt wells. In 1819 oil was accidentally obtained in boring two salt wells on the Muskingum River in Ohio. It was used to a limited extent in the workshops in the neighborhood, but did not prove a satisfactory substitute for the animal and vegetable oils in use, as lamps suitable for burning it had not been invented. The oil was considered a great evil on account of its interference with the manufacture of salt. In 1829 a flowing well had been accidentally obtained at Burksville, Kentucky, and for two or three weeks the oil flowed over the surface of the Cumberland River and became ignited, causing some apprehension of conflagration by the inhabitants of the towns and villages lower down on the river.

Col. Drake decided, on the law of probabilities, that if on two occasions people had drawn oil by accident through salt wells from the bowels of the earth, there was no reason why he could not secure it by intention in the same way; therefore, much to the amusement of his friends and the Pennsylvania farmers, he began to bore an artesian well for oil, and on the 26th day of August, 1859, at a depth of 71 feet, the drill suddenly dropped into a cavity, and in a few minutes the oil made its appearance at the surface and flowed at the rate of 400 gallons a day. This oil sold for 55 cents a gallon at the well. The success of this oil well, as can readily be imagined, created a great excitement throughout the country. There was immediately a rush of prospectors to Oil Creek, and in a few months there appeared a forest of derricks in the valley, and numerous wells were bored.

The success which attended this enterprise led to prospecting in other districts, and wells were bored in West Virginia, Ohio, Kentucky, Indiana, and elsewhere. No mining enterprise had ever offered such

* Read at the nineteenth annual general meeting of the Society in London, in the theater of the Royal Institution, Albemarle Street, on Wednesday, July 18, 1900, Prof. C. F. Chandler, President of the Society, in the chair.

sudden fortunes. A well costing a few thousand dollars might yield, if successful, from 100 to 2,000 barrels daily with no expense for pumping. The Noble well yielded in a little more than one year 500,000 barrels of oil; the Sherman well, over 450,000 barrels of oil in two years. The poor farmers of Oil Creek, who could not previously have realized more than a few dollars per acre for their land, suddenly found themselves wealthy. Single farms brought their owners from $500,000 to $1,000,000, with a royalty on the product in addition in some cases. One farmer received $3,000 per day in royalty.

Before the end of 1859, 82,000 barrels of oil had been obtained. This amount increased in 1860 to 500,000. It then rose into the millions. This industry rapidly expanded. Special railroads were built into the oil country, pipe lines were laid, numerous refineries were constructed, a great export trade grew up, until at present petroleum, crude or refined, constitutes one of the most important items of export from the United States, and the price has been reduced to a figure which in comparison with the cost of oil in old times is almost ridiculous.

A little more than a year ago, refined petroleum in bulk sold for 3½ cents per gallon. During the past year, however, the prices have advanced somewhat because the yield of oil did not keep pace with the demand and the visible stocks began to decrease at the rate of 8,000 barrels per day. Within a few weeks, however, some new oil territory has been developed, and prices have begun to go down.

Great interest attaches just now to the vicinity of Garner, Pa., where a well has just been completed which produces 2,000 barrels per day.

A 7,000 barrel gusher was recently completed near Alexandria, Indiana. Reports from Madison, in the same State, say that the territory in that country is developing far better than was previously expected. In the West Virginia, Ohio, and Indiana fields activity continues with good results.

The number of wells completed in the Pennsylvania, Ohio, and Indiana fields during May was 1,489, and the total new production was 22,071 barrels.

It must be remembered, however, that while these new wells and this new production is secured, the old wells are constantly falling off.

The following table, compiled by The Oil City Derrick, shows recent operations in the various fields producing Pennsylvania oil:

	Dec.	Jan.	Feb.	March.	April.	May.
Wells completed.....	813	633	591	590	797	839
Daily average, new production..	8,574	8,198	7,701	7,058	12,402	11,242
Average, per well.....	13½	16½	16½	15½	20½	18½
Dry holes	194	140	123	153	183	2.0
Rigs up and building	443	459	404	428	382	451
Wells, drilling..... ..	665	653	668	673	702	721
Total, new work..	1,198	1,112	1,072	1,101	1,184	1,174

It is an interesting fact that although not widely removed from each other geographically, the two great oil fields of America, that of Pennsylvania and that of Ohio and Indiana, are widely removed from each other in geological position. The oil of Ohio and Indiana is very much older than that of Pennsylvania. It occurs in the lower Silurian limestone, while that of Pennsylvania occurs in the upper Devonian rocks, in several horizontal strata of cavernous sand rock, between layers of compact black shale, hundreds of feet in thickness. This difference in mineralogical association is illustrated in an interesting way by the methods employed in reviving exhausted oil wells. In Pennsylvania, in order to break up the sand rock and open communication with fresh oil-bearing cavities, two or three hundred quarts of nitro-glycerine are let down into the well and exploded.

In this way the yield of Pennsylvania petroleum has been greatly increased. In Ohio and Indiana, however, where the rock is limestone, hydrochloric acid is employed to accomplish the same purpose. Fifty or more carboys of hydrochloric acid are forced to the bottom of the oil well, which is then plugged to prevent the escape of the carbonic acid gas liberated, and to produce a pressure and thus force the acid into every crevice of the rock. The result is similar to that obtained with nitro-glycerine, though accomplished in a different way.

There is an important difference in the oil of these two great fields; that of Pennsylvania is comparatively free from sulphur and furnishes by the ordinary treatment of fractional distillation and agitation with sulphuric acid, an oil free from disagreeable odor; but the oil of Ohio and Indiana, like that of Canada, contains a large amount of sulphur, about one per cent. in compounds, of an exceedingly offensive odor. For a long time it was supposed to be impossible to prepare from this petroleum an oil sufficiently free from odor to be available for illuminating purposes, but the invention of Mr. Frasch proved a complete success, and by its application makes it possible to obtain an entirely satisfactory oil. The process consists in first fractioning the crude petroleum and then deodorizing the fractions by distilling them off oxide of copper kept in suspension by proper agitators, the oxide of copper being recovered and used over and over again.

WATER GAS.

Parallel with this development of cheap oil for burning in lamps, we have had corresponding improvements in the manufacture of illuminating gas. Prior to 1870, illuminating gas was manufactured in the United States exclusively from bituminous coals, largely from the coking coals from Nova Scotia and the Western States, enriched with cannel coal from Virginia or Pennsylvania, or with albertite from Nova Scotia, grahamite from West Virginia, boghead coal from Scotland, or similar materials. The gas averaged about 16 candle power, and the price in New York city was $3.75 per 1,000 cubic feet. The new departure in gas making began with the establishment of the Tessie du Motay process of making water gas in New York city. The subject of water gas was an old one, and had been discussed and experimented upon for 50 years more or less, but there were two or three difficulties in the way of its manufacture in Europe. The decomposition of steam by red-hot carbon was perfectly feasible with the production of a mixture of hydrogen and carbonic oxide, but there was no convenient economical method for imparting to this non-luminous gas the power of giving light. There was no material cheap enough for the purpose. The petroleum industry made this possible in the United States. We had an abundance of cheap petroleum naphtha which could be obtained at from three to five cents per gallon, and five gallons per 1,000 feet were sufficient to impart to the mixture of hydrogen and carbonic acid the necessary illuminating power. In the Tessie du Motay process, the non-luminous water gas was manufactured from steam and anthracite coal, and was stored in a gas-holder. It was impregnated with naphtha by passing it through a carbureting machine which contained a large number of flat trays charged with naphtha. In order to fix this naphtha and prevent its being condensed in the mains, the mixture of gas and naphtha vapor was passed through long gas retorts maintained at a red heat, in order to crack up the naphtha and convert it into permanent gases. The product was then washed and purified in the usual way to remove tar and sulphur, etc. Great difficulty was at first experienced in regulating the temperature of the fixing retorts, which were heated by external fires. If they were not hot enough the naphtha was not cracked into permanent gases. If they were too hot, the rich light-giving gases were destroyed, and carbon was deposited in the retorts. A very ingenious device was hit upon by Mr. Bradley, the superintendent, for regulating the temperature. He placed on the exit pipe of each fixing retort a small stopcock, and provided the foreman with pieces of paper lined off in squares corresponding to the number and position of the fixing retorts. At regular intervals the stopcock was opened, and the gas from the fixing retort, without being lighted, was allowed to impinge upon the proper square of the piece of paper. A spot was produced varying in color from yellow through different shades of brown to black. The medium shade was the proper one, and the foreman was expected to so regulate the fires in the benches as to secure the proper shade of color on the testing paper. This process of Tessie du Motay was afterward introduced by the New York Gas Company on the east side of the city. As this water gas process was controlled by patents, it was quite natural that the old gas company should be very much opposed to its introduction, and every effort was made to secure legislation from some authority to prevent it. The matter came before the Health Department of the city, of which I was at that time the president, and after careful investigation the Health Department decided that the gas was such an improvement in quality and price, and the increased danger from this gas over the old-fashioned gas was so slight, that it was not wise to interfere with it.

This gas resulted in reducing the price ultimately to about $1 per 1,000 cubic feet, and the average quality is between 26 and 27 candle power. This in place of bituminous coal gas at $3.75 per 1,000 feet, with an illuminating power of 16 to 17 candles. Appeals were made to the Board of Aldermen and to the Legislature to put a stop to the manufacture of water gas, but the consensus of opinion in the United States has been in favor of this new gas, and we do not believe that its use entails any great increase in the danger attending the use of any illuminating gas. It is true that it contains from 25 to 30 per cent. of carbonic oxide, while the old-fashioned gas contained from 7 to 13 per cent. It is also true that we have a certain number of deaths, accidental or suicidal, and perhaps occasionally criminal, from breathing illuminating gas—more, probably, than we had 50 years ago; but I think not many more than properly corresponds to the greatly increased use of gas, resulting from its cheapness and brilliancy. While the Tessie du Motay process did not extend beyond New York city, the water gas industry has taken almost complete possession of the entire country. There are 30 or 40 different forms of apparatus for manufacturing it, but they are almost without exception applications of the invention of Thaddeus Lowe.

The Lowe process consists in employing a fixing chamber, previously heated by internal combustion, in contradistinction to a fixing chamber continually heated by an external fire. The Lowe apparatus consists of a generator filled with anthracite or coke, through which air is first blown to bring the fuel to a high state of incandescence. Air is admitted above the coal, to support the combustion of the generator gas in the adjacent fixing chamber. At the end of a few minutes the air blast is turned off, steam is turned on, and the exit to the gas holder is opened. At the same time there is injected above the mass of incandescent fuel the necessary quantity of either crude petroleum or some cheap petroleum product, such as gas oil or naphtha. This oil is immediately vaporized and mixed with the water gas. It then passes into the fixing chamber, which may be either above or at the side of the generator. This fixing chamber, having been previously heated by the combustion of the generator gas, is at a proper temperature for cracking and fixing the oils, and the finished illuminating gas is delivered from the apparatus.

In 1896 Mr. Walton Clark made a careful inventory of gas companies in the United States, and found the processes in use divided as follows:

Companies using coal gas (generally small).	418
Companies using water gas	296
Companies using water gas mixed with coal gas	116
Companies using oil gas	108
Companies using miscellaneous processes..	13
Total.....	951
Total using water gas.....	412

During 1897, 1898, and 1899, and the first five months of 1900, the United Gas Improvement Company erected or are now erecting 133 sets of water gas apparatus. Of these, 11 are for new companies and 23 are additions to original installations. It seems safe to say that there are at least 500 gas companies using water gas wholly or in part. It is estimated that there were sold in the United States in 1899, 70,000,000,000 cubic feet of gas, of which 75 per cent. or 52,500,000,000 cubic feet were carbureted water gas.

During the last year or two the price of petroleum products has advanced to such an extent that the manufacturers of water gas are beginning to question the possibility of continuing to supply water gas at current prices; and as the public would never consent to have the price of gas raised, they have been looking about for some substitute for the present process. The great improvements in late years in the coke ovens designed to save the by-products of bituminous coal, that is, the gas and ammonia, have made it possible to manufacture the old-fashioned bituminous coal gas at a much lower price than formerly, and it is quite probable that if the high price of petroleum product continues, we may see a gradual abandonment of the water gas industry and a return to the old-fashioned coal gas. This change has been already accomplished for the city of Boston. There has been erected at Everett, near Boston, large works for supplying the city.

I am informed that at the Everett works the coke ovens of G. Hoffman are employed, and that 400 of them are now in use. These retorts are rectangular, about 60 feet long. They are provided with Siemens' regenerative furnaces. Each retort is charged with 6 tons of bituminous coal from Cape Breton, Nova Scotia, which can be delivered in Boston for less than $3 a ton. The process of coking begins with generator gas from a special furnace; the combustion takes place in a series of flues which pass around and through the retorts. When the temperature reaches a red heat, a portion of the gas generated from the coal is switched into the furnaces, and the coking is continued with this material. I understand that from 30 to 50 per cent. of the gas produced is employed in heating the retorts. 2,400 tons of coal are coked daily, and the coke is employed in the locomotives of the Boston and Maine Railroad. The tar and ammonia water are collected, and it is estimated that 12,000 tons of sulphate of ammonia will be produced per annum at these works, and a corresponding quantity of coal tar.

The Slovay Alkali Company, of Syracuse, has also established a large coking plant, primarily to secure ammonia for its alkali process. The retorts employed are shorter than those in use at Everett, having a capacity of 4½ tons of coal.

(To be continued.)

THE PHOTOGRAPHIC METHOD OF PREPARING TEXTILE DESIGNS.*

THE preparation of designs for the loom has, throughout the history of weaving, been regarded as a purely manual process controlled by the intelligence, ingenuity, and skill of the craftsman. It is only natural, therefore, that the invention of apparatus for this specific purpose should have created much interest among both British and foreign textile experts. Photography as understood and practised appeared as incapable of aiding the artist in the actual painting of his picture as the designer in the transference and execution of the plain sketch of the pattern on to the "scale" paper for the loom. Within the wide range of technical and scientific data in the construction and embellishment of woven fabrics there is perhaps no phase of the work more difficult to assail, by mechanical devices, than the application and adjustment of the manifold "weave" units which compose all figured textiles.

Design acquired in the loom is a distinct type of ornamentation involved in varied technicalities. It is not the result of one, but of a number of processes, overlapping each other, and yet uniting to construct and perfect the same woven effect. Fabric and design have to be simultaneously obtained. These can only be divorced by resorting to the arts of printing, embroidery, and painting. Obviously, in the preparation of the "design" sketch for weaving, numerous limitations have to be encountered, which on a first consideration seem liable to be increased rather than diminished by a photographic process of design development. Much ingenuity has been exercised by Szczepanik in his solution of these "weave" problems. Szczepanik's apparatus is not for the origination of designs either in the theoretical or technical form, for in both processes the knowledge of the expert is demanded; but its province is to lessen, and in some instances dispense with, the monotonous manual labor necessitated by the present system. There are large areas of point paper in elaborate designs to which the same weave effect has to be applied, and where some labor-saving device is much needed. Further, in the enlargement of the artist's sketch to scale there is much mechanical work that it ought to be possible to reduce. The photographic inventions of Szczepanik profess to accomplish these objects, and the designs submitted prove that there are possibilities of success in certain styles of pattern. A new field for experiment has been discovered, the extent of which it is not possible to forecast, but it may reasonably be anticipated that the genius and temerity of the discoverer will prove equal to its more complete exploration.

The essential purpose of Szczepanik's invention is to develop from the ordinary sketch and enlarge to a prescribed scale the technically-prepared design, marked with the thousands or may be millions of dots grouped in different orders and so fitted together as to impart precise definition to the several portions of the woven figure or design. The process is threefold, consisting: (1) of the preparation of the ruled paper; (2) the development of the design from an ordinary photographic negative; and (3) the application of the weave units to the several parts of the figure. Primarily, the apparatus consists of an optical lantern with a suitable arrangement of lenses. One important factor is the "raster" or multiplying plate, containing some 435,600 perforations, through each of which the weave type passes, and is printed on the enlarged design. In addition there are weave plates for determining the details of the pattern, and small metal slides for producing particular sections in distinct forms of type, so that they may be as readily distinguished from each other as if sketched in various colors.

The light from the lantern passes through the negative of the design, entering a pair of lenses between which is fixed the small metal plate of the proper shape for developing the marks on the sensitized paper. The process consists in dividing and subdividing the "scale" pattern into rectangular spaces, and of mark-

* Abstract of a paper read before Section G of the British Association at Bradford, by Prof. Beaumont.

ing each with the correct weave type. When there is no negative in the lantern, this type is repeated as many times as there are holes in the perforated plate, showing the feasibility of marking every square photographically on any kind of weaver's paper.

In the first place, the negative is made of the complete design, and all parts erased but the ground sections, allowing of these being printed with their supplementary weave elements. Negatives of every part of the pattern are similarly printed in succession until the entire design has been obtained. For the production of shaded work, e. g., portraits and pictorial subjects, selecting plates are employed. These secure an accurate graduation of tones perfectly in harmony with the photograph from which they are derived. Provision is made for the execution of patterns in compound as well as in single structure fabrics; but it follows, the more complex the build of the texture, the more intricate the process of design production. Certain textile designs may evidently be produced photographically by the Szczepanik system, so that it is now a question for demonstration whether designs so produced are comparable in legibility and equal for all practical purposes—as forcible in detail, as vital in execution—as those prepared by the much slower hand method.

Fig. 1.—VON ZEPPELIN'S AIRSHIP IN ITS HOUSING.

THE FIRST TWO TRIAL TRIPS OF VON ZEPPELIN'S AIRSHIP.

The second day of July will long be remembered by aeronauts, for on that day occurred the first ascension of the great airship just completed by Count von Zeppelin, the cavalry officer of Württemberg who has so long been superintending the construction of his balloon in a huge floating house on Lake Constance.

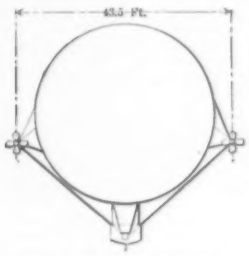


Fig. 2.—END VIEW.

Count Zeppelin, like all originators of great schemes, has had many unexpected difficulties to contend with, not the least of which was, probably, a tempest which tore his great floating house from its moorings and did other damage, which was repaired only at great expense of time and labor as well as of money. Numerous other accidents interfered with the ascension of his balloon, but finally June 30 was officially given out as the date of the first trial. On that day thousands of people gathered on the shores of the lake, and the water was covered by a fleet that included craft of all kinds, from the fisherman's primitive boat to the most modern private steam yacht and launch. The crowd was doomed to disappointment, however, for the inflation of the airship was not completed and no ascent could be made. Toward night of the second day the raft on which the airship rested was towed out of the floating house. Even on the third day it seemed doubtful for some time whether any ascension could be made, but finally, the last rope was cut at three minutes after eight, the sliding weight was quickly regulated, and the airship began to move, trying to rise in a graceful curve, which, however, was interrupted at a height of about 150 feet by what seemed to be a rather strong current of air, but it is said that the line connected with the sliding weight became entangled with a line from one of the side propellers. The ship was carried along with the wind in the direction of Immenstadt, where it descended to the water at 8:20, having attained a height of something over 1,300 feet and covered a distance of three and a half miles, traveling with the wind, at a speed of 26 feet per second. During this trial trip von Zeppelin occupied the forward car with an amateur, Mr. von Bassus, of Munich, and an engineer, while in the rear car were the African explorer, Eugen Wolf, and a machinist.

Although all the hopes and expectations of the promoters and friends of the enterprise were not realized, the results obtained were interesting and important, and, as far as the ascent and descent were concerned, entirely satisfactory; but it was evident that the amount of energy developed by the propellers was insufficient. Instead of the promised speed of over 30 feet per second, a speed of only 26 feet per second was really obtained.

The second trial was made on October 17, and was far more successful than the attempt of July 2.

Leaving the balloon house at Manzell at a quarter of five o'clock, the ship immediately rose to a height of about 300 meters (984 feet), and traveled fairly regularly eastward with the east-northeast wind as far as Meersburg, a distance of 11 kilometers (6·8 miles). It then made a wide detour and headed again for Manzell. But the night was growing apace, and the flying machine came down in the lake at five minutes past six.

The occupants of the first car were Count von Zeppelin, Lieutenant von Crogh, and Engineer Burr, and of the second, Herr Eugen Wolf and Engineer Gross.

A dispatch to The London Standard from Friedrichshafen says that when the airship rose the wind was from the northeast, blowing with a velocity of three and one-half yards a second. When the airship had attained a height of 400 yards, it described a circle and then drove with the wind in a generally circular direction for about six miles. It then again described a circle, after which it made headway against the wind, which was then blowing with increased velocity. Eventually the airship descended with great ease and steadiness into the lake. The experiment was most successful. The airship's stability, equilibrium and steering powers were excellent.

Von Zeppelin's ship consists of a colossal aluminium frame, 416 feet in length, 38 feet in diameter, which, in cross-section, is a twenty-four-sided polygon. The cross-sectional area of the balloon body is only 1114·72 square feet, and the entire air-resisting surface, projected upon a vertical plane, has an area of 1188·87 square feet.

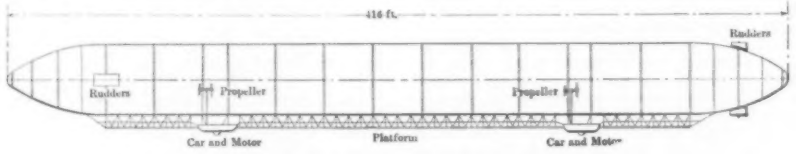


Fig. 3.—SIDE ELEVATION OF THE AIRSHIP.

The frame is composed of aluminium trellis work, covered with a fabric of which the upper surface is composed of pegamoid, and the under surface of silk. A netting of ramie fiber, which covers all the metal construction, protects this double envelope from injury by the wire framework. The body of the balloon is divided into seventeen compartments, each of which is designed to contain a gas-bag. Of these compartments, fifteen are 26 feet long, and the remaining two 13 feet long. The gas-bags are likewise protected from injury by ramie netting. Above and below the front portion of the balloon body and at each side of the rear portion, rudders are located. The two four-bladed screw-propellers are mounted at each side of the balloon body, at a height approximately equal to that of the center of air resistance. Each propeller has a diameter of 3·77 feet, and a speed of 1,100 revolutions per minute. The propellers, it was thought after the first trial, were not large enough. Whether they have been taken out and others substituted can not as yet be ascertained.

The merit of this compartment construction is evident enough. Although it increases the weight considerably, it tends to preserve longitudinal stability; for the shifting of the gas caused by oscillation of the longitudinal axis is confined to very small spaces and is, therefore, rendered almost inappreciable.

Six and one-half feet below the balloon body, and rigidly connected therewith, is an aluminium platform or bridge, 301·76 feet long, connecting two aluminium cars, each containing a 16 horse power motor and a 23·778 gallon tank, holding sufficient benzine for a run of ten hours. Beneath the airship a rope is suspended (omitted in Fig. 3) upon which a sliding weight (220 pounds) is carried, which can be adjusted to keep the ship in proper longitudinal trim.

Comparing the ever memorable airship of Renard and Krebs, which had a maximum cross-sectional area of 595·225 square feet, with von Zeppelin's balloon, we find that the cross-sectional area of the latter is 1·95 times greater. The experiments of Renard-Krebs and of Tissandier proved that the actual velocities attained by airships were proportional to the cubic roots of their motive powers, acting upon the same cross-sectional area. For a cross-sectional area of 100 square meters, 29 horse power of the total 32 will be available for von Zeppelin's balloon; in the airship of Renard and Krebs, 14·87 horse power were necessary for a speed of 6·5 meters per second. Hence the theoretical speed of von Zeppelin's airship should be:

$$v = 6{\cdot}5\sqrt[3]{\frac{29}{14{\cdot}87}} = 8{\cdot}12 \text{ m. (30·6336 feet) per second.}$$

In this calculation we have not considered factors in favor of Zeppelin's airship, such, for example, as the form and rigidity of the resisting surfaces, the lateral arrangement of the screws at about the height of the central point of resistance. The actual speed obtained on the first trial was but 26 feet per second; but the experiment was by no means conclusive. It is to be hoped that the speed obtained in the second trial more fully realizes the inventor's expectations.

The question naturally arises: How great must be the power to drive a vessel with the 110·449 square meters (1188·87 square feet) maximum cross-sectional area of von Zeppelin's airship? The most trustworthy formula applicable to the problem is that of Ritter von Loessl, which reads:

$$R = \frac{8}{g} F v^2 \sin \alpha.$$

In this equation R = resistance of the air to an inclined surface; g = acceleration of gravity (980·94 centimeters per second); F = the area of the surface in square meters; v = the relative velocity in meters per second of the resisting surface in air; α = the inclination of the surface to the horizontal. Roughly substituting von Zeppelin's quantities in von Loessl's formula, we obtain: $R = \frac{8}{10} . 110 . 8^2 \sin 30^\circ = 352$ kilogrammes wind pressure. Hence we obtain for the energy necessary to drive the ship at an approximate speed of 8 meters per second, $352 \times 8 = 2816$ kilogrammemeters = 20368·73 foot pounds, which divided by 550 gives approximately 37 horse power.

In this computation the favorable form of the nose has not been considered. Since in the Renard-Krebs airship the calculated horse power was found to be considerably in excess of that actually required, von Zeppelin was justified in assuming that 32 horse power would be amply sufficient.

The weight of both motors is 1,430 pounds; the hourly consumption of fuel, about 26·4 pounds. Since the ballast of the airship will consist entirely of water, the cooling water need not be added to the weight of the motors. The total weight of von Zeppelin's motors is therefore reduced to 45·54 pounds per horse power hour. The driving shaft is geared to two diagonal shafts which drive the propellers.

The balloon body of von Zeppelin's airship con-

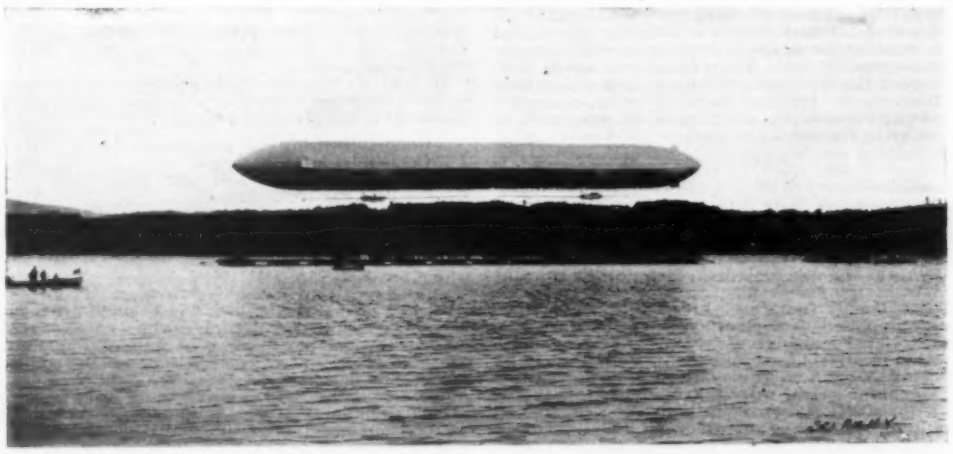


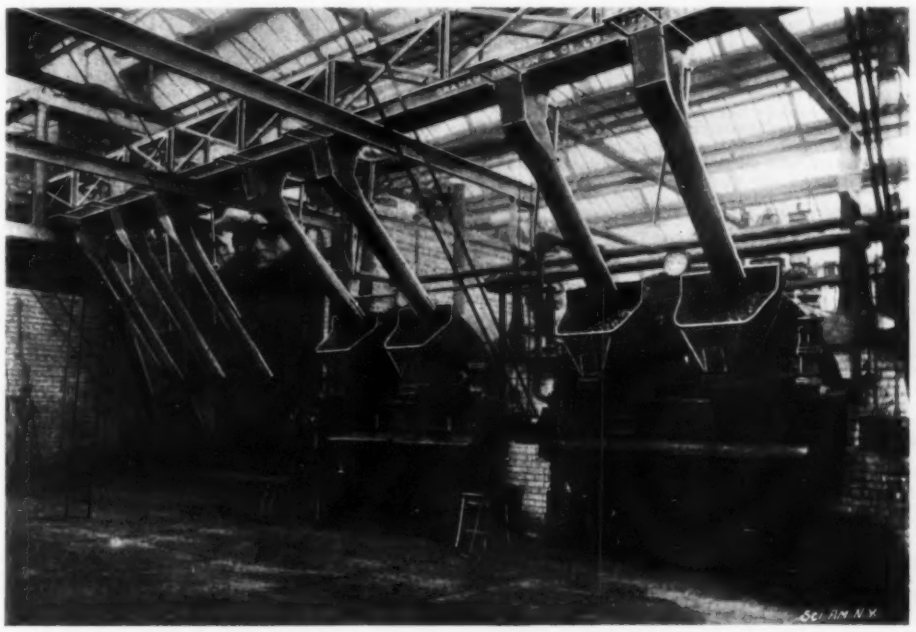
Fig. 4.—THE ASCENT OF THE AIRSHIP.

tains 11,300 cubic meters (399,059·5 cubic feet) of gas and consequently has a lifting capacity of 10 tons. From calculations which have been made, the total weight, including the crew, is equal to 10,000 kilogrammes (9 tons), leaving 1 ton as a remainder.

At the previously mentioned speed of 8·12 meters per second, 288 kilometers or 179 miles will be the normal radius of the ship. But since the lifting capacity is such that 800 to 1,000 additional pounds of benzine can be carried, the ship can readily journey from thirty to forty hours, so that its radius will be considerably increased.

A NEW AUTOMATIC COAL HANDLING PLANT.

AT the Municipal Electric Supply Station of the city of Leeds, in England, has recently been established a new system of machinery for the automatic



AUTOMATIC CONVEYING PLANT SUPPLYING LANCASHIRE WATER-TUBE BOILERS.

handling of coal. Through the courtesy of the designer of this installation, Mr. Harold Dickinson, A.M.I.C.E., the chief electrical engineer to the corporation, we are enabled to give a description and illustration of this plant.

For efficiently illuminating the city with a sufficient supply of electric light, 5,000 horse power is requisite. The steam for generating this power is supplied by a battery of eight Lancashire and one Babcock & Wilcox water-tube boilers. These boilers are ranged in a building 177 feet in length by 63 feet in width. The Lancashire boilers are each 30 feet long by 8½ feet diameter. Originally the coal was conveyed to the stores in carts, and the furnaces trimmed by hand, but the engineer found this process both slow and expensive. Thereupon he set to work to contrive a plant in which all these operations should be performed without having recourse to manual labor at all.

In this plant the coal is tipped from the carts into a boot elevator at one end of the building. It is then raised by the elevator and delivered to a conveyor, which carries it along, and deposits it in heaps in the stores, which are placed on the ground floor. Below this floor is a conveyor trench along which the conveyor is drawn from any part of the stores to a second elevator, which delivers it to a push plate conveyor that runs over the fronts of the boilers. From this conveyor project in a downward direction spouts through which the coal is passed to the self-acting stokers attached to the boilers. One very prominent feature of this plant is that in feeding the elevators by means of an automatic feeder, the buckets each receive a regular charge of coal, and it is consequently impossible for the elevator boot to be choked.

The conveyor is a substantial structure built of channel iron. The chains used in the conveyors are stamped steel roller chains, by which means friction is greatly reduced. Two endless strands of chain are employed for this conveyor, the rollers running along the channel irons of the trough. The conveyor is adjusted by means of a hexagonal drum arranged with tightening screws. The driving end of the conveyor is built up of rolled steel joists firmly secured to the wall, and the trailing end is supported by means of hanging brackets in the trench.

Through the coal stores extends a rampway for cartage. Underneath the coal stores there is a trench 150 feet in length by 5 feet wide and 6½ feet deep. In this conveyor trench the return half of the continuous conveyor is placed; also immediately beneath the coal stores are the patent automatic feeders connected to the conveyor by means of chutes. These feeders are in every case driven by means of spur and pinion wheels from the line shaft and connected up with claw clutches, which are operated by levers fixed in the rampway. When coal is required from any portion of the stores, a feeder is put in motion by means of these levers, and the coal is then taken to the required boiler by means of the conveying plant.

The conveyor is 177 feet in length and is sufficient to cope with the amount of coal required. Two spouts are provided to each of the Lancashire boilers, and three to the water-tube boiler. The plant has been given a thorough trial and has been found satisfactory in every way. At present the capacity of the plant is 15 tons per hour, but there is no doubt that if the exigency arose, this amount could be increased.

BLAST FURNACE GAS MOTOR.

THE Société Cockerill at Seraing has an exhibit at the Exposition, a gas motor, that merits the attention of the industrial world, since it represents a remarkable progress made in the utilization of the gases of blast furnaces. Combustible gases have long been used for heating boilers which themselves produce the steam necessary for the engine that actuates the air compressor. But this mode of heating presents drawbacks. The calorific power of the gases is from 900 to 1,000 calories kgdegree per cubic meter, and wide heating surfaces and spare boilers are necessary on account of the accumulation of dust.

The Société Cockerill long ago observed that a blast furnace that produces 100 tons of iron per 24 hours emits 200,000 cubic meters of gas, which disengages a quantity of heat equal to about 300,000,000 calories kgdegree. Such a volume of gas, utilized in gas motors, might furnish about 2,800 horse power. The power absorbed by the blast furnace does not exceed 800 horse power. There results, then, great losses of power that an effort ought to be made to utilize.

The Société Cockerill conceived the idea of addressing M. E. Delamare-Deboutteville and of proposing to him the problem of the direct utilization of blast furnace gases by means of gas motors. This problem presented great difficulties, especially in the way of lighting and in the construction of the motors.

The satisfactory results obtained, however, prompted the Société Cockerill and M. Delamare-Deboutteville to undertake the construction of a single cylinder motor of from 500 to 600 horse power, and this is the one that figures at the Exposition.

The motor was set running on the 20th of November, 1899, and was submitted to a series of very complete experiments on the 20th and 21st of March, 1900, under the direction of M. Hubert, engineer in chief of mines.

The dimensions of the motor are as follows: diameter of the cylinder, 1·3 m.; stroke of the piston, 1·4 m.; diameter of the compressor, 1·7 m.

The air compressor is actuated in tandem in the rear prolongation of the piston rod of the motor.

The first trials took place on the 20th of March, with the brake and indicator, with the object of determining the consumption of gas and water, as well as the industrial and thermal renderings. Five experiments were at first made and gave the following results. The indicated power was 786·16 horse power with an angular velocity of 94·37 revolutions per minute. The effective power at the brake was, on an average, 575 horse power at 41·9 admissions per minute, or 87·8 per cent. The mean industrial rendering was therefore 73·14 per cent. The consumption of gas and water was as follows: gas at 0° and at a pressure of 760 mm., 2·556 cubic meters per indicated horse hour, and 3·495 cubic meters per effective horse hour; water, 56·8 liters per indicated horse hour and 12·7 liters per effective horse hour. The mean temperature of the water was 7·86° at the entrance of the cylinder and 33·17° at the exit. The temperature of the gases was 9° at the entrance and 508·5° at the exit.

As regards the calorific power of the gases in the same conditions of temperature and pressure, the figures determined by the Yuncker calorimeter were found to be 915·22 calories kgdegree per cubic meter, and those determined by the Witz calorimetric bomb were 984·4 calories kgdegree per cubic meter, presenting a difference between them of 9·3 per cent. M. Hubert explains this difference by saying that the experiment made with the calorimetric bomb was not effected under the same conditions of explosion as in the gas motor, in which, in fact, the combustion does not take place under a constant volume.

M. Hubert likewise distinguishes two kinds of rendering. The first is the thermic rendering, or ratio of the quantity of heat corresponding to the effective work to the quantity of heat disengaged by the gases, all the losses of energy through friction and other passive resistances apart. The second is the total thermic rendering, or ratio of the quantity of heat corresponding to the effective work to the total quantity of heat brought into play and comprising the heat of the gases and that disengaged in the brake.

The thermic rendering, determined by means of the Yuncker calorimeter, was 27·16 per cent. and the total thermic rendering 19·86 per cent. The total thermic rendering, determined by the Witz bomb, was 18·46 per cent.

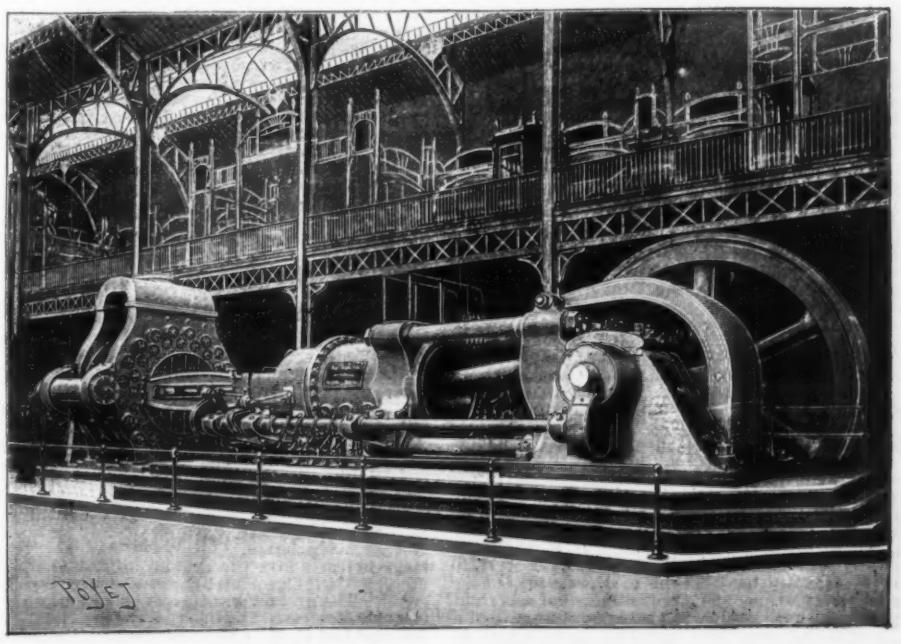
A sixth experiment, made under full charge, gave the following results:

Indicated horse power	825·88
Effective horse power	670·02
Consumption of gas per indicated horse hour (at 0° and a pressure of 760 mm.) in cubic meters	2·56
Angular velocity in number of revolutions per minute	93·2
Number of admissions in per cent	99
Industrial rendering in per cent	81·12
Thermic rendering (Yuncker calorimeter) in per cent	27·11
Total thermic rendering (Yuncker calorimeter) in per cent	22·03
Total thermic rendering (Witz bomb)	20·48

As may be seen, this first series of experiments gave very satisfactory results. A second series was made on the 21st of March, 1900, with the air compressor actuated by the motor under normal conditions of industrial practice. Five experiments were made at a mean charge and five others at a full one. At a mean charge, the number of admissions per minute was 36·306, say 86·5 per cent.; the indicated horse power was 746·815, and the effective horse power in wind blast, 562·570.

The consumption of gas reached 2·345 cubic meters per indicated horse hour, and 3·113 cubic meters per effective horse hour; and the output of water was 51·83 liters in the cylinder and 13·4 at the piston. The calorific power of the gases was found, by means of the Yuncker calorimeter, to be 876·25 calories kgdegree in the morning and 888 calories kgdegree in the afternoon, and the thermic rendering of the motor was 30·92 and 30·66 per cent. The total thermic rendering was 23·29 and 23·25 per cent. M. Witz has determined the calorific power of the gas by means of his bomb and has found it to be 991 calories kgdegree in the morning and 1,004·33 in the afternoon. The thermic rendering was, therefore, 27·34 and 27·11 per cent., and the total thermic rendering 10·6 and 22·17 per cent.

In these various experiments a few facts were observed that it is well to mention. In the experiments of March 20 the total charge was suppressed and re-established at various times. The motor operated without showing



BLAST FURNACE GAS BLOWING-MACHINE.

any variations in velocity greater than 3 per cent. On March 21, the pressure of the compressed air was increased. The motor operated with an angular velocity which fell from 94·2 to 62 revolutions per minute, and the mean pressure of the gas in the cylinder rose to 5·67 kgdegree per square centimeter instead of 4·79. The indicated power was 700·5 horse power and the effective power 577·5. The industrial rendering was 82·4 per cent.

It may be concluded that 78 per cent. of the total heat disengaged was converted into work in the motor, 52 per cent. was given up to the feed water, and 20 per cent. carried off by the gases as a loss. The important problem of the direct industrial utilization of the gases of blast furnaces in motors is definitely solved, and we owe such success to the studies and researches of M. Delamare-Debouttéville and the engineers of the Société Cockerill. M. Greiner, director general of this establishment has not ceased to take the greatest interest in all the researches, and has delivered two remarkable lectures at the Iron and Steel Institute upon blast furnace gas motors. It is in great part to his able direction that the industry now owes this new progress.—For the above particulars and the engraving, we are indebted to La Nature.

SPECIAL REPORT ON THE GALVESTON HURRICANE OF SEPTEMBER 8, 1900.

By Isaac M. Cline, Local Forecast Official and Section Director.

The hurricane which visited Galveston Island on Saturday, September 8, 1900, was, no doubt, one of the most important meteorological events in the world's history. The ruin which it wrought beggars description, and conservative estimates place the loss of life at the appalling figure, 6,000.

A brief description of Galveston Island will not be out of place as introductory to the details of this disaster. It is a sand island about thirty miles in length and one and one-half to three miles in width. The course of the island is southwest to northeast, parallel with the southeast coast of the State. The city of Galveston is located on the east end of the island. To the northeast of Galveston is Bolivar Peninsula, a sand spit about twenty miles in length and varying in width from one-fourth of a mile to about three miles. Inside of Galveston Island and Bolivar Peninsula is Galveston Bay, a shallow body of water with an area of nearly five hundred square miles. The length of the bay along shore is about fifty miles, and its greatest distance from the Gulf coast is about twenty-five miles. The greater portion of the bay lies due north of Galveston. That portion of the bay which separates the island west of Galveston from the mainland is very narrow, being only about two miles in width in places, and discharges into the Gulf of Mexico through San Louis Pass. The main bay discharges into the Gulf between the jetties; the south one being built out from the northeast end of Galveston Island and the north one from the most southerly point of Bolivar Peninsula. The channel between the jetties is twenty-seven to thirty feet in depth at different stages of the tide. There are channels in the harbor with a depth of thirty to thirty-five feet, and there is an area of nearly two thousand acres with an anchorage depth of eighteen feet or more. The mainland for several miles back from the bay is very low, in fact, much of it is lower than Galveston Island, and it is so frequently overflowed by high tide that large areas present a marshy appearance. These are, in brief, the physical conditions of the territory devastated by the hurricane.

The usual signs which herald the approach of hurricanes were not present in this case. The brick-dust sky was not in evidence in the smallest degree. This feature, which has been distinctly observed in other storms that have occurred in this section, was carefully watched for, both on the evening of the 7th and the morning of the 8th. There were cirrus clouds moving from the southeast during the forenoon of the 7th, but by noon only alto-stratus from the northeast were observed. About the middle of the afternoon the clouds were divided between cirrus, alto-stratus, and cumulus, moving from the northeast. During the remainder of the 7th, strato-cumulus clouds prevailed, with a steady movement from the northeast. A heavy swell from the southeast made its appearance in the Gulf of Mexico during the afternoon of the 7th. The swell continued during the night without diminishing, and the tide rose to an unusual height when it is considered that the wind was from the north and northwest. About 5 A. M. of the 8th Mr. J. L. Cline, observer, called me and stated that the tide was well up in the low parts of the city, and that we might be able to telegraph important information to Washington. He having been on duty until nearly midnight was told to retire and I would look into the conditions. I drove to the Gulf, where I timed the swells, and then proceeded to the office and found that the barometer was only one-tenth of an inch lower than it was at the 8 P. M. observation of the 7th. I then returned to the Gulf, made more detailed observations of the tide and swells, and filed the following telegram addressed to the Central Office at Washington:

"Unusually heavy swells from the southeast, intervals one to five minutes, overflowing low places south portion of city three to four blocks from beach. Such high wa er with opposing winds never observed previously."

Broken stratus and strato-cumulus clouds predominated during the early forenoon of the 8th, with the blue sky visible here and there. Showery weather commenced at 8:45 A. M., but dense clouds and heavy rain were not in evidence until about noon, after which dense clouds with rain prevailed.

The wind during the forenoon of the 8th was generally north, but oscillated, at intervals of from five to ten minutes, between northwest and northeast, and continued so up to 1 P. M. After 1 P. M. the wind was mostly northeast, although as late as 6:30 P. M. it would occasionally back to the northwest for one or two minutes at a time. The prevailing wind was from the northeast until 8:30 P. M., when it shifted to the east, continuing from this direction until about 10 P. M. After 10 P. M. the wind was from the southeast, and after about 11 P. M. the prevailing direction was from the south or southwest. The directions after 11 P. M. are from personal observations. A storm velocity was not attained until about 1 P. M., after which the wind increased steadily and reached a hurricane velocity about 5 P. M. The greatest velocity for five minutes was eighty-four miles per hour at 6:15 P. M., with two miles at the rate of one hundred miles per hour. The anemometer blew away at this time, and it is estimated that prior to 8 P. M. the wind attained a velocity of at least one hundred and twenty miles per hour. For a short time, about 8 P. M., just before the wind shifted to the east, there was a distinct lull, but when it came out from the east and southeast it appeared to come with greater fury than before. After shifting to the south at 11 P. M. the wind steadily diminished in velocity, and at 8 A. M. on the morning of the 9th was blowing at the rate of twenty-six miles per hour from the south.

The barometer commenced falling during the afternoon of the 6th and continued falling steadily, but slowly, up to noon of the 8th, when it read 29·42 inches. The barometer fell rapidly from noon until 8:30 P. M. of the 8th, when it registered 28·48 inches, a fall of pressure of about one inch in eight and one-half hours. After 8:30 P. M. the barometer rose at the same rapid rate that had characterized the fall. The barograph trace sheet during this storm, from noon September 6 to noon September 10, is inclosed. On account of the rapid fall in pressure, Mr. John D. Blagden, observer, took readings of the mercurial barometer as a check on the barograph, and his readings are as follows:

Time.	Readings.	Time.	Readings.
5:00 P. M.	29·05	6:40 P. M.	28·75
5:11 P. M.	29·00	6:48 P. M.	28·70
5:30 P. M.	28·95	7:15 P. M.	28 69
5:50 P. M.	28·90	7:40 P. M.	28·62
6:06 P. M.	28·86	8:00 P. M.	28·55
6:20 P. M.	28·82	8:10 P. M.	28·53

These readings confirm the low pressure shown by barograph and indicate the great intensity of the hurricane.

Mr. Blagden looked after the instruments during the hurricane in a heroic and commendable manner. He kept the wires of the self-registering apparatus intact as long as it was possible for him to reach the roof. The rain gage blew away about 6 P. M., and the thermometer shelter soon followed. All the instruments in the thermometer shelter were broken, except the thermograph, which was found damaged, but has been put in working order.

Storm warnings were timely and received a wide distribution not only in Galveston but throughout the coast region. Warning messages were received from the Central Office, at Washington, on September 4, 5, 6, 7 and 8. The high tide on the morning of the 8th, with storm warnings flying, made it necessary to keep one man constantly at the telephone giving out information. Hundreds of people who could not reach us by telephone came to the Weather Bureau Office seeking advice. I went down on Strand Street and advised some wholesale commission merchants who had perishable goods on their floors to place them three feet above the floor. One gentleman has informed me that he carried out my instructions, but the wind blew his goods down. The public was warned, over the telephone and verbally, that the wind would go by the east to the south and that the worst was yet to come. People were advised to seek secure places for the night. As a result thousands of people who lived near the beach or in small houses moved their families into the center of the city and were thus saved. Those who lived in large, strong buildings, a few blocks from the beach, one of whom was the writer of this report, thought that they could weather the wind and tide. Soon after 3 P. M. on the 8th conditions became so threatening that it was deemed essential that a special report be sent at once to Washington. Mr. J. L. Cline, observer, took the instrumental readings while I drove first to the bay and then to the Gulf, and finding that half the streets of the city were under water, added the following to the special observation at 3:30 P. M.: "Gulf rising, water covers streets of about half city." Having been on duty since 5 A. M., after giving this message to the observer, I went home to lunch. Mr. J. L. Cline went to the telegraph offices through water from two to four feet deep, and found that the telegraph wires had all gone down; he then returned to the office, and by inquiry learned that the long distance telephone had one wire still working to Houston, over which he gave the message to the Western Union telegraph office at Houston to be forwarded to the Central Office at Washington.

I reached home and found the water around my residence waist deep. I at once went to work assisting people, who were not securely located, into my residence, until forty or fifty persons were housed therein. About 6:30 P. M. Mr. J. L. Cline, who had left Mr. Blagden at the office to look after the instruments, reached my residence, where he found the water neck deep. He informed me that the barometer had fallen below 29·00 inches; that no further messages could be gotten off on account of all wires being down, and that he had advised everyone he could see to go to the center of the city; also, that he thought we had better make an attempt in that direction. At this time, however, the roofs of houses and timbers were flying through the streets as though they were paper, and it appeared suicidal to attempt a journey through the flying timbers. Many people were killed by flying timbers about this time while endeavoring to escape to town.

The water rose at a steady rate from 3 P. M. until about 7:30 P. M., when there was a sudden rise of about four feet in as many seconds. I was standing at my front door, which was partly open, watching the water, which was flowing with great rapidity from east to west. The water at this time was about eight inches deep in my residence, and the sudden rise of four feet brought it above my waist before I could change my position. The water had now reached a stage 10 feet above the ground at Rosenberg Avenue (Twenty-fifth Street) and Q Street, where my residence stood. The ground was 5·2 feet elevation, which made the tide 15·2 feet. The tide rose the next hour, between 7:30 and 8:30 P. M., nearly five feet additional, making a total tide in that locality of about twenty feet. These observations were carefully taken and represent to within a few tenths of a foot the true conditions. Other personal observations in my vicinity confirm these estimates. The tide, however, on the bay or north side of the city did not obtain a height of more than fifteen feet. It is possible that there was five feet of backwater on the Gulf side as a result of debris accumulating four to six blocks inland. The debris is piled eight to fifteen feet in height. By 8 P. M. a number of houses had drifted up and lodged to the east and southeast of my residence, and these with the force of the waves acted as a battering ram against which it was impossible for any building to stand for any length of time, and at 8:30 P. M. my residence went down with about fifty persons who had sought it for safety, and all but eighteen were hurled into eternity. Among the lost was my wife, who never rose above the water after the wreck of the building. I was nearly drowned and became unconscious, but recovered through being crushed by timbers, and found myself clinging to my youngest child, who had gone down with myself and wife. Mr. J. L. Cline joined me five minutes later with my other two children, and with them and a woman and child we picked up from the raging waters, we drifted for three hours, landing three hundred yards from where we started. There were two hours that we did not see a house nor any person, and from the swell we inferred that we were drifting to sea, which, in view of the northeast wind then blowing, was more than probable. During the last hour that we were drifting, which was with southeast and south winds, the wreckage on which we were floating knocked several residences to pieces. When we landed, about 11:30 P. M., by climbing over floating debris to a residence on Twenty-eighth Street and Avenue P, the water had fallen four feet. It continued falling, and on the following morning the Gulf was nearly normal. While we were drifting we had to protect ourselves from the flying timbers by holding planks between us and the wind, and with this protection we were frequently knocked great distances. Many persons were killed on top of the drifting debris by flying timbers after they had escaped from their wrecked homes. In order to keep on the top of the floating masses of wrecked buildings, one had to be constantly on the lookout and continually climbing from drift to drift. Hundreds of people had similar experiences.

Sunday, September 9, 1900, revealed one of the most horrible sights that ever a civilized people looked upon. About three thousand homes, nearly half the residence portion of Galveston, had been completely swept out of existence, and probably more than six thousand persons had passed from life to death during that dreadful night. The correct number of those who perished will probably never be known, for many entire families are missing. Where 20,000 people lived on the 8th not a house remained on the 9th, and who occupied the houses may in many instances never be known. On account of the pleasant Gulf breezes many strangers were residing temporarily near the beach, and the number of these that were lost cannot yet be estimated.

That portion of the city west of Forty-fifth Street was sparsely settled, but there were several splendid residences in the southern part of it. Many truck farmers and dairymen resided on the west end of the island, and it is estimated that half of these were lost, as but very few residences remain standing down the island. There is not a house in Galveston that escaped injury, and there are houses totally wrecked in all parts of the city. All goods and supplies not over eight feet above floor were badly injured, and much was totally lost. The damage to buildings, personal and other property in Galveston County is estimated at about thirty million dollars. The insurance inspector for Galveston states that there were 2,636 residences located prior to the hurricane in the area of total destruction, and he estimates 1,000 houses totally destroyed in other portions of the city, making a total of 3,636 houses totally destroyed. The value of these buildings alone is estimated at $5,500,000.

The grain elevators which were full of grain suffered the smallest damage. Ships have resumed loading, and work is being rushed day and night. The railroad bridges across the bay were washed away, but one of these has been repaired, and direct rail communication was established with the outside world within eleven days after the disaster. Repairs and extensions of wharves are now being pushed forward with great rapidity. Notwithstanding the fact that the streets are not yet clean and dead bodies are being discovered daily among the drifted debris, the people appear to have confidence in the place and are determined to rebuild and re-establish themselves here. Galveston being one of the richest cities of its size in the United States, there is no question but that business will soon regain its normal condition and the city will grow and prosper as she did before the disaster. Cotton is now coming in by rail from different parts of the State and by barge from Houston. The wheels of commerce are already moving in a manner which gives assurance for the future. Improvements will be made stronger and more judiciously; for the past twenty-five years they have been made with the hurricane of 1875 in mind, but no one ever dreamed that the water would reach the height observed in the present case. The railroad bridges are to be built ten feet higher than they were before. The engineer of the Southern Pacific Company has informed me that they will construct their wharves so that they will withstand even such a hurricane as the one we have just experienced.

I believe that a sea wall, which would have broken the swells, would have saved much loss of both life and property. I base this view upon observations which I have made in the extreme northeastern portion of the city, which is practically protected by the south jetty; this part of the city did not suffer more than half the damage that other similarly located districts, without protection, sustained.

From the officers of the U. S. Engineer tug "Anna," I learn that the wind at the mouth of the Brazos River went from north to southwest by the way of west. This shows that the center of the hurricane was near Galveston, probably not more than 30 miles to the westward. The following towns have suffered great damage, both in the loss of life and property: Texas City, Dickinson, Lamarque, Hitchcock, Arcadia, Alvin, Manvel, Brazoria, Columbia, and Wharton. Other

towns further inland have suffered, but not so seriously. The exact damage at these places cannot be ascertained.

A list of those lost in Galveston, whose names have been ascertained up to the present time, contains 3,536 names.

United States Weather Bureau Office. Galveston, Tex., September 23, 1900.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Industrial Conditions in South Africa.—During my recent trip through the Orange River Colony, and the South African Republic, my attention was called to the destruction of wire fencing, says Consul-General J. G. Stowe, of Cape Town. For hundreds of miles the fences are down and twisted so badly that they cannot be used again. The wooden posts have all been burned for cooking purposes and warmth, and, as there is but little wood in this country, iron posts must be substituted. The government must fence anew along the lines of railways, and the farmers in the interior must fence also. Plowing was in progress, but the area is limited as compared with former years, and, therefore, no great demand for agricultural implements may be expected, although many have been allowed to rust and go to ruin. The market for cereals and products of the soil will continue to be large. By March, 1901, a renewal of the demand for farming machinery may be looked for. Meat and live stock will continue to be imported. There was only three days' supply of fresh meat in Johannesburg when I left there. Although the reoccupation of Johannesburg by the mining and business population can hardly be expected for at least three months, preparations are being made at the seaports, much machinery and goods are stored, awaiting the time of shipment, and orders are being placed abroad. The Boers who have returned to their homes are desirous of getting to work, but several months must elapse before things settle down to a normal basis.

The imperial government is building railways from Pretoria and Johannesburg to the Orange River Colony border, and engines and cars will be needed. Over one thousand freight cars have been recently ordered by the Cape colonial railways. A new railway is being built from Harrismith, in Cape Colony, to connect with the Orange River Colony Railway, so that there will be two competing lines from the seaports in Cape Colony and Natal to Johannesburg, breaking the monopoly of the Netherlands Railway in the South African Republic, with its 200 per cent. profit per year. The new railways will provide sidings for all the mines in Johannesburg, these being very much needed. The bridges over streams and culverts have been destroyed, with few exceptions, and temporary structures erected, and deviations of tracks to reach the lower levels were made. As a result, a demand for bridge material, such as girders, etc., may be expected. Electric and telegraphic materials and supplies will also be wanted. Coal machinery and household and house-building supplies will be needed.

I note that Lord Roberts has appointed an "advisory committee" for the purpose of assisting him in the opening of Johannesburg to trade and commerce; to arrange for the return of the mining population, in order that the main industry of the Rand may resume operation; and to arrange for the municipal administration. The mines must be opened in order that the industry upon which Johannesburg and South Africa largely depend may be put in operation to support shopkeepers and the general population of such a city. Like all mining towns, Johannesburg had its full measure of undesirable inhabitants, and it is a question if this element will be allowed to return.

The supply of gold having been exhausted, the resumption of mining will bring improvement in every department of trade. New enterprises will spring up, and orders to the value of millions of pounds sterling will be placed in the next two years. The manufacturers of the United States will, with effort, get their share. The following article from The British and South African Export Gazette is so apropos that I insert it.* I wish all our manufacturers and producers who desire to export to South Africa would read this paper. I would be glad to mail copies to anyone on receipt of 15 cents in stamps.

[Extracts from inclosure.]

"Electrical Goods in South Africa.—It is, perhaps, hardly ten years since the discovery of the rich gold-bearing reefs of the Witwatersrand, but during this period the most marvelous collection of machinery of all sorts has been installed over a line of country about 40 miles in length. There is yet room for a great deal more, as it is a well-known fact that many of the small mines have never been properly developed and many of the large mines have neglected their extensions and deep levels. It will not be many months before the mines will be again occupied and the question of new electrical machinery gone into. Then will it be seen how much of the old machinery has been irreparably damaged by neglect and by water; and, inspired by confidence in the new state of things, orders will go out broadcast for this machinery and for plant which the mines have been waiting for years to put down. New schemes will be taken in hand, new districts developed, and, what is more, every bit of machinery will be wanted at once.

"Who is in the Best Position to Fill the Orders?—In the early days of the Rand, things went pretty much the way of the English manufacturer, and direct-current dynamos from England tumbled into the country as fast as they could be made. But after a little while there came a change over the scene. The Frankford exhibition was held, polyphase dynamos and motors were shown in operation over long distances, and the superiority of this system for the transmission of power was demonstrated. And then slowly but surely the polyphase machine began to get an entrance into the Transvaal, to the exclusion of the direct-current plant and to the benefit of the foreigner. But the English manufacturer made no move; he has hardly begun to do so now. The result is that the trade has largely gone away from England. In the first place, the Germans and the Swiss benefited largely by this new state of things; but they were greatly handicapped by the demand for similar machinery at home.

"American Enterprise.—In the meantime, however, the Americans had been adopting polyphase machinery on a large scale, and, what is more, standardizing and making a special study of it. Being more enterprising than their Continental rivals, they sent men to Johnannesburg, and not only opened agencies, but even went so far as to form a supply company for certain mines. What was the result? Americans are as clannish as the Scotch, and it became the case of the unclean spirit who found the house swept and garnished. American machinery required Americans to understand it, the mines engaged them. These engineers required Americans to drive their machinery; they were forthcoming. New machinery was required; specifications were drawn up by the American engineers in their own language and indicating their own type of machinery.

"English Conservatism.—English makers could not or would not always quote to new patterns; they had made certain patterns all their lives, and they were not going to change now. To the next thing was but a short step; what more natural than that American dynamos must have American engines to drive them, American pumps to feed the boilers, and to be driven by American motors, and so on ad lib. And now the Rand is full of American engineers, American practice is de rigueur, and American terms are the vernacular. Specifications are already being handed around for machinery which contain many words strange to our ears, and which clearly indicate their source and the type of machinery required.

"What Will the English Manufacturer Do?—Now where does the English manufacturer stand? Orders for machinery to the value of millions of pounds will be given out in the course of the next year or two, not only for mines, but for towns, which will increase rapidly in size. How many of these orders will he get? Will he strive to get out of his groove? Will he send out or appoint agents who are conversant with the requirements of new countries, or will he continue to try and force them to take the plant he has made for years? It is for him to answer, and not for us, but let it be understood that we do not grudge the Americans their success; it is due entirely to their enterprise and our lack of it that they are now more or less in a position to dictate as to the origin of the machinery required. We only wish to issue a warning in time, now that a new state of things is springing up, so that the English manufacturer may get his fair share of the plums.

"Other Markets in Danger.—Apart from the question of polyphase machinery, which he is now beginning to make, there are many other directions in which he is at a disadvantage with the Americans. Take the question of overhead-line equipment, for instance. Why is it that we have to buy so much of this material from the States, not only for the Transvaal, but also for our own requirements at home? Are our own insulator makers energetic enough? Another point which applies less to the mines than to the towns is the supply of car bodies and trucks for electric tramways. Hot countries like Africa require open cars or cars without windows and with top canopies; are we going to continue to make closed cars only, because the Englishman is satisfied to travel in the summer in a rolling black hole of Calcutta rather than force the tramway companies to put on cars with open sides in the hot weather?

"English Can but Will Not Make to Order.—It is not as if the English manufacturer can not make these things. Indeed, he can make them in every respect as well as the Americans, and the solidity of his work is generally better. But he must standardize his goods rather more, so as to offer them at a lower price and in a shorter time if he wishes to secure his share in the growing South African trade. There is room enough out there for everybody, but we can not afford to let our colonies and our new territories become the dumping ground solely for American machinery or see all the good posts filled by Americans after we have fought for them ourselves."

I found all the banks open in Johannesburg and Pretoria, but, of course, not doing much business. The stores were largely barricaded and the city looked desolate. In a few months this beautiful city, the greatest gold-mining locality in the world, will commence a new era. But little damage has been done to property. The mines are in good condition and are being pumped.

I trust that our manufacturers and producers who desire to export will take advantage of the openings in South Africa. We do not want exhibitions of American products or elaborate catalogues or price lists; we want "hustlers" such as the United States produces—men to come and study the market, ascertain its needs and wants, and bring samples with them. South Africa is an importing country, and it has gold and diamonds and copper to pay for its purchases.

In the United States, the daily paper is the best medium of advertising, and, as there are no trade papers published here as at home, the daily or weekly papers would be a good medium by which to bring our products to the attention of the consumers.

*Extracts from the article are printed herewith.

German Exhibits in Paris.—Consular Agent Harris writes from Eibenstock, September 1, 1900:

The Paris correspondent of The London Daily Mail says that the Germans have taken full advantage of the opportunities offered by the exhibition and are pushing their commerce. He adds:

Their official catalogue, published in various languages, is a most artistic production. The volume is most beautifully printed in colors, handsomely bound, and it contains not merely a list of exhibits, but exhaustive articles on German industries and on the industrial history of the country.

One has only to glance at this volume to realize how adept the Germans are in the art of attracting attention to their wares and how well their official representatives have worked the exhibition.

American Fruits in Germany.—The prospect for an unprecedented export of American dried prunes, apricots, peaches, and pears, as well as evaporated apples and raspberries, to Germany this autumn and winter is exceedingly bright, provided the crop in the United States is sufficiently plentiful to furnish a large supply at reasonable prices. The popularity of American dried and preserved fruits in this country has increased from year to year, by reason of both their relative cheapness and their unrivaled flavors and excellence, until a leading wholesale dealer in such products at Berlin informs this consulate that his applications from his customers—who are mainly grocers and provision dealers in other towns and cities—are larger this season than ever before and relate almost exclusively to American fruits.

California prunes are rapidly supplanting the fine but expensive French product and the low-grade Bosnian prunes in the German market, and there is nothing here that can successfully compete with the dried pears and peaches and evaporated apples from the United States.

It will therefore be of interest to American exporters to know that the tedious and annoying inspection of dried fruits at the German frontier—as a precaution against the supposed danger from the San José scale—has been discontinued since the first of last month, so that the way is now open to an unrestricted trade. Last year, the supply of American dried fruit was insufficient to meet the demands of the German market; but this year large contracts have been made by American merchants, who, after visiting the Paris Exposition, have come to this country and, combining business with travel, have visited the principal German cities and personally offered their products to the more important dealers.

As to fresh fruits, the inspections at the frontier will be still maintained, but it is believed in a fair and liberal spirit. It is noted in this connection that hitherto cases of San José scale have been found most frequently among the highest and most expensive class of apples, such as are wrapped in tissue paper and put up in boxes for family and hotel use, whereas such infection has rarely been detected in the common grades of apples, which are packed loosely in ordinary barrels. This probably results from the fact that the choicest American apples come from a State or district specially infected by the scale, whereas the States along the northern frontier—New York, Michigan, Wisconsin, and Iowa—are generally free from it. It is suggested by the German importers that if, before being wrapped and packed, the high-class apples could be wiped or brushed, especially at the ends of the core, whatever scale exists might be easily removed, and thus whole shipments of such expensive fruit, now liable to be condemned, would be enabled to pass the inspection without danger.—Frank H. Mason, Consul-General at Berlin.

Threatened Industrial Crisis in Europe.—The wave of industrial prosperity in Europe, which has steadily risen since 1895, has taken a turn and begun to recede. All signs point toward a crisis in industrial and financial lines, which may occur before two years have passed. Any political disturbance of note may bring on the crisis suddenly and without warning. Coal mining is still "booming," as the supply is not equal to the demand. The iron and steel works, including the manufacture of many lines of machinery and steel plates for warships, have orders which it will take some months to fill, but factories making small ironware, nails, needles, bicycles, sewing machines, etc., are curtailing production and reducing working forces and wage scales.

There are doubts if the immensely capitalized electrical works of Germany and other countries can keep fully employed after present contracts are filled. This line of industry, which in Germany alone represents an investment of nearly $300,000,000, has been largely instrumental in creating the present boom.

Failures have already begun in the building trade, which in the large cities has been of a speculative nature and rested mainly on borrowed capital. Rents for business houses and dwellings have advanced, but will topple upon the first beginning of a business crisis.

Shipowners are still jubilant, owing to the phenomenal advance in ocean transportation rates which was brought about by the South African war and the present troubles in China.

The German papers speak in alarming tones of the sad position of the textile industry, where stoppages of factories are the order of the day. Late statistics of the Gera district show 6,022 looms idle, out of a total of 11,829. The weavers still employed there earn but 8 to 10 marks ($1.904 to $2.38) per week. This wretched wage, which is to support a family, is next to a starvation rate, especially as fuel and provisions have greatly advanced in price and the poor operative must pay government tax and school rate besides.

The stock market is the delicate seismometer which denotes the coming upheaval. Shares of industrial companies have already commenced to decline, though the reports of their operations promise for this year large dividends. The high interest rates which have ruled for money this year and the high taxes which capitalists and business interests must pay in Germany have also tended to affect the boom.—Simon W. Hanauer, Vice Consul-General at Frankfort.

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No. 854, October 9.—Railways in Uruguay—Russian Excise Duties—Beet-Sugar Industry of France—Proposed Port Works at Montevideo—Steamship Service for West Coast of America—Issue of Treasury Bills in Nicaragua.

No. 855, October 10.—French State Railway Coal Contracts—United States Coal in Europe—Prussian Freight Rates on Coal—Coal in Hongkong—Coal in Costa Rica—Coal in Martinique—Brazilian Demand for Coal—American Coal in Genoa—Coal for Swedish Railways.

No. 856, October 11.—Typesetting Machines in Europe.

No. 857, October 12.—Argentine Trade in 1900—Fruit Market in Siberia—Permits for Travelers in Roumania—*American Railroad Cars in Bavaria—Export of Ammunition from the Netherlands—German Exports of Woolen Cloth to United States.

No. 858, October 12.—Rebate in Nicaraguan Tariff.

No. 859, October 13.—Trade-Marks in Germany—Trade-Marks in Denmark—Economic Conditions in Indo-China—Bananas in Costa Rica—Amnesty Act in Peru—*German Machinery Exposition in Russia.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

PARIS EXPOSITION.

TRANSPORTATION—CENTENNIAL COLLECTION.

THE most important of the government collections of the Champ de Mars is the centennial collection of objects of all descriptions relating to transportation. It has been arranged by a committee of which M. Bixio, president of the Paris Cab Company, is the head. The collection occupies a large space on the ground floor of the Transportation building, and includes a great number of historic coaches, post chaises, sedan chairs, and like vehicles, as well as early forms of bicycles and moto-cycles. In the collection are represented different forms of saddles, harness, etc., besides articles of voyage, engravings, and other objects.

One of the interesting collections is that showing the development of the bicycle. On the right of the illustration will be seen some of the primitive forms; the first of these dates from 1795. It has a curiously shaped wooden body with a horse's head carved in front; upon this a stuffed leather seat is supported by two pieces of bent iron. The rear wheels are carried by two wrought iron straps attached to the body, while the front wheel is mounted on a wrought iron fork, the shaft of which passes above and supports a wooden guide-bar. The wheels are of wood, with iron tires of large surface. This is probably one of the oldest velocipedes existing. Beside it are two others of somewhat similar construction; the bodies are of wood and each carries a horse's head in front; the first bears the date 1798, and the second 1810. The latter has two rather large wheels of about the same diameter, the rear wheel being the larger. Next to it is a velocipede built in 1847 at Rouen. It has a curved body of wood, the front wheel being carried, like the others, in an iron fork. In this velocipede the rear wheels are operated by hand by means of a lever formed of two upright bars pivoted at the middle of the body, and projecting up in front of the seat; the latter is of stuffed leather and is mounted considerably above the body. The lady's bicycle next to it is another singular construction, although it presents some points of resemblance with the modern form. The frame, of wrought iron, is bent down between the front and rear wheels, and is protected by a wide leather band. The rear wheels are worked by cranks which pass to two levers below the seat. The velocipede of 1867 begins to resemble the modern bicycle, and it is to be remarked that the two wheels are of nearly the same size; a more elaborate form is that which belonged to the Count of Anjou, this being constructed entirely in metal, and is finely finished. The type of 1878 presents the well known form of machine with the large front wheel and very small rear wheel. Next to it is a tandem which resembles in its main design the ordinary form, but in addition to the foot pedals, the rear wheel has a long vertical lever by which it is also worked by hand from the rear seat, the two movements being combined.

To the right of the illustration is the first steam tricycle built by De Dion and Bouton at Paris in 1885. The main platform carries two front wheels and a rear wheel of smaller diameter. The boiler is mounted between the front wheels, and the cylinder is below the platform, in the center; it works the rear wheel by means of an eccentric. The large vehicle in the rear is a steam diligence built by Amedée Bollée, senior, at Mans; it has two compartments in the center, and in the rear is a platform containing a large boiler. The engine is mounted underneath, and drives the rear wheels by a set of intermediate gearing and chain wheels. In front is the platform for the driver, with the controlling mechanism.

In one of the illustrations is shown a post chaise of 1789, containing two figures in the costume of the time; the horse in front shows the arrangement of the harness, and the whole has a very life-like appearance. The caleche seen in the rear is of more elaborate construction, being a four-seated vehicle with a double seat behind for servants, two of which are shown in costume. In the vehicle is represented a lady in the costume of the period, while an officer stands below in the act of opening the door; the postilion is mounted on a high seat in front. The small model seen in the case represents a diligence of 1830, which traveled between Paris and Strasburg; it has been loaned by by Messrs. Schmidt, of the latter city.

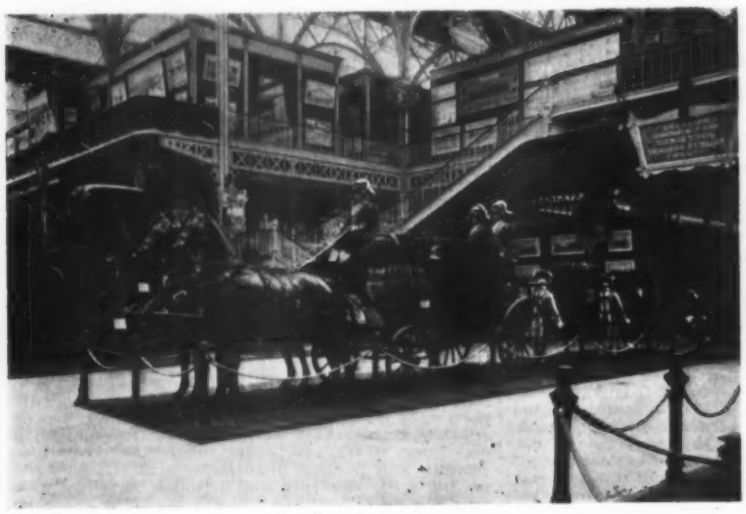
One of the interesting vehicles of the collection is the coach belonging to Napoleon III., which is shown in the illustration; it is loaned by Prince Joachim Murat. It is of the form known as "demi-gala," and was drawn by four or six horses, two of which are represented. The body of the coach is dark blue and green; the harness, of black leather, is ornamented with bronze pieces bearing the imperial coat of arms. The uniform of the driver and footmen is in dark blue and gold. The lamps in the front and rear of the coach are of bronze, of fine workmanship. In the rear of the coach is a sedan chair in the style of Louis XIV.; the body is of maroon leather, finished with brass nails, having a coat of arms on the front and sides; the carriers wear a livery of buff and red.

Another illustration shows a coach of the eighteenth century, known as a "carosse de grand gala," with two of the horses. The body of the coach is decorated with paintings, and is finished in gold relief designs. The framework of the coach is handsomely carved and finished in red and gold, as also the wheels. The harness is of white leather, embroidered with blue silk, and carries bronze relief ornaments. The uniforms of the driver and footmen are in dark blue and red. Next to it is a litter of the time of Louis XIV. carried by mules. It is loaned by Viscount de Cholet. The body is finished in green and gold designs, with ornamental carvings.

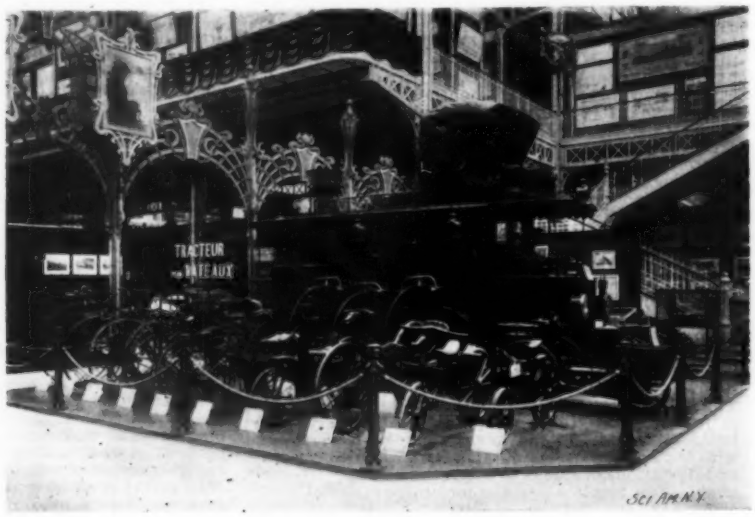
The collection contains a number of vehicles of great historic interest. One of these is the royal coach belonging to the princes of Spain, in which King Ferdinand VII., the Infante Don Carlos, and Don Antonio made the voyage from Madrid to Valencay, where they were kept by order of Napoleon from 1808 to 1814. It is a richly decorated, but a very primitive coach, the framework being formed mainly of wooden beams, painted and gilded. It is loaned by Prince Talleyrand Perigord. Near it is a traveling carriage which belonged, after the Revolution, to the Countess Tyszkiewicz, who made the voyage in it from Russia to France; later on it was the property of the Countess de Vauban, and then passed into the family of the Hunolstein. The traveling coach of Marechal Mortier is another interesting vehicle; it belonged at first to the Duke of Angoulême, who used it in the Spanish campaign of 1823. Marechal Mortier, who was sent as the ambassador of France to Russia, made the voyage from Paris to St. Petersburg in this coach. The same route was covered by the traveling coach of General de Caulaincourt, also ambassador to Russia, at an earlier date, the voyage and return being made in 1807. It has been loaned by the Count d'Espenilles. A vehicle of later date is the post chaise built in 1842 for the use of the house of Rothschild; it made the voyage between Paris and Frankfort. It is a two-seated vehicle, with a large space in front for the post-boxes; the driver's seat is high in the front. This vehicle has been loaned by Baron Alphonse de Rothschild.

A large number of sedan chairs and litters of different epochs are to be seen; most of these are ornamented in different colors, with gilding or metal work, and present a great variety of designs. Among these may be mentioned a mule litter whose origin goes back to about 1760; during the Revolution it was kept at the chateau of La Motte Fouquet. It is of a buff color, with armories of the houses of Falconer and Bezons. It is borne by two mules in harness. Another litter, which has been loaned by the Count de la Rochefoucauld, belongs to the period of Louis XVI.; it is richly decorated with gilding and painted panels and the interior is lined with red damask. Among the sedan chairs, that given by Marie Antoinette to her sister Queen Marie Caroline of the Two Sicilies is one of the most interesting; it is in the style of Louis XVI. and carries the armorial bearings of the Two Sicilies on the front and sides. Another sedan chair of the same epoch is finished in fine wood carving, with painted panels on a gold background; the metal fittings are in chased bronze. It belongs to the Duc de Lorge.

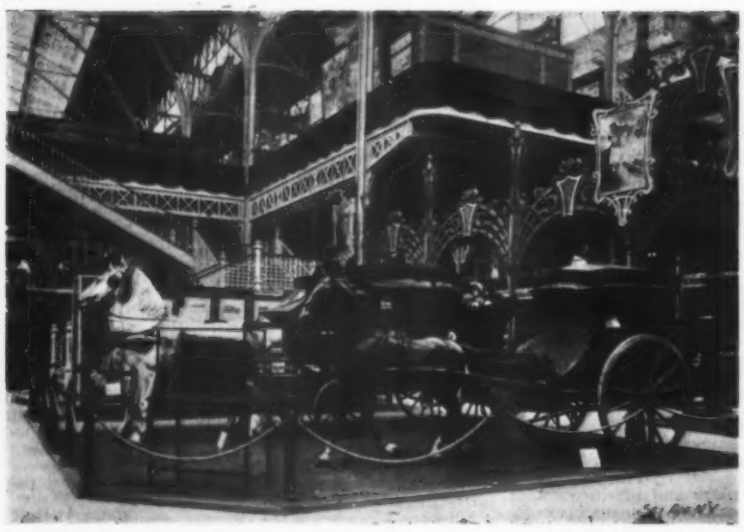
A number of cases contain wax reproductions of ancient saddles in one-fifth size, in which all the different forms from the middle ages to the present time may



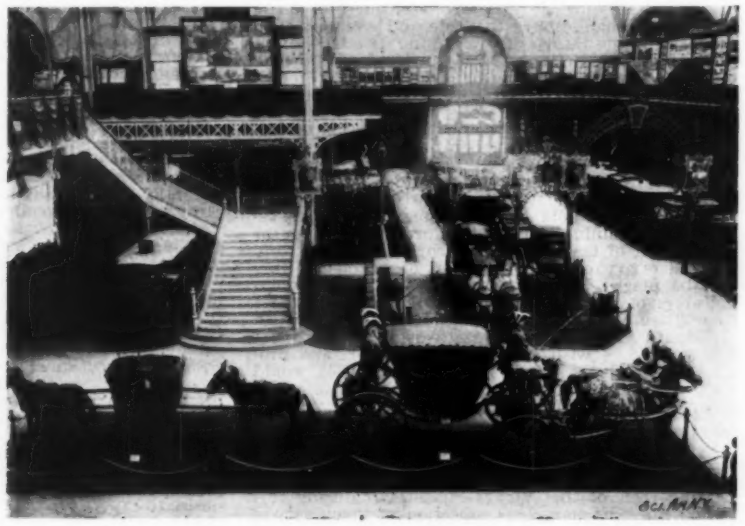
COACH OF NAPOLEON III.



THE EVOLUTION OF THE BICYCLE—BOLLÉE STEAM DILIGENCE IN THE BACKGROUND.



POSTAL CHAISE.



EIGHTEENTH CENTURY COACH.

EXHIBITS IN THE TRANSPORTATION BUILDING, PARIS EXPOSITION.

be noted. A large case contains models of ancient vehicles of various forms, sedan chairs and different modes of transportation. Near it is an interesting collection of old saddles; some of these are in white, red and green leather embroidered and decorated in different styles. A large case contains a collection of harness, among which may be remarked the harness of state for eight horses made for Napoleon III. Its style is quite similar to that seen on the large coach; it is of black leather, carrying relief ornaments of bronze. The reins are embroidered in red and gold.

A number of cases contain bits, stirrups, and other parts of harness. A very ancient bit comes from the south of Italy; it belongs to the Greco-Roman period, about 600 B.C., having been found by the Baron Spinelli during the excavations which he had made in his grounds near Naples, and which covered the site of the ancient city of Sessnola. A number of other bits are shown, as well as spurs, stirrups, etc., dating from various epochs, most of which are very handsomely ornamented. The riding coat and vest worn by Napoleon III. are shown, these having been loaned by Count de Perigord. The coat is of blue cloth with gold braiding, and the vest is of red velvet.

The collection contains a large number of engravings relating to the different methods of transportation; many of these have been loaned by M. Bixis. The collection of time tables, maps, guides, and ancient documents is very complete; the latter include a number of royal and imperial edicts relating to the postal service. In another part of the collection are to be seen two locomotives of early date. The first of these was built by George Stephenson, and was the first to run upon a public railroad. It ran on the Whiteside and Canterbury Railway, which was opened on May 3, 1831. It consists of a large boiler mounted upon two trucks with large wheels. The cylinders are placed near the front in an oblique position, and operate the rear wheels by a simple piston and slide. The valve mechanism, of a very primitive kind, is connected by iron rods. The cylinders are 10 by 18 inches. In front is a simple tubular smokestack. The second engine is of later date, and was constructed near Rouen, in 1844, for the express trains from Paris to Rouen.

CURIOSITIES IN CLOCKWORK AT THE EXPOSITION OF 1900.

A HIGH-PRICED CLOCK.—Almost all those who inspect the wonderful things contained in the Petit Palais stop in front of the superb white marble clock due to the chisel of Falconnet, and representing the Three Graces. This clock eclipses all others. Nevertheless, there is in a neighboring showcase a handsome little clock of gilded bronze, representing the same subject, sculptured by Saint-Germain, and formerly belonging to the collection of La Dubarry, but now the property of the State.

All eyes, however, are attracted toward the work of Falconnet, and the reason is that this piece, independently of an unquestionable artistic value, has recently acquired an accidental one. In fact, it is related (truly or otherwise) that this clock, which belongs to Count Isaac de Camondo, was intended by him for the Museum of the Louvre, when a very rich amateur made him an offer for it of a million or a million and a half francs, which was refused. Then the offers increased to such a point that the Count, it is said, conceived the idea of allowing the museum to take its choice between the object and the sum of money.

All this talk has been singularly amplified, and in the salon in which the clock is exhibited the story has recently been current that the sum offered was eight million francs.

However, what is certain is that this piece, which is very beautiful, has fetched various prices. It was sold, not originally, but after the Revolution, for 1,500 francs to M. Bannheim. Then Baron Double purchased it for 7,000 francs, and, at the sale of his property in 1881, Count Abraham de Camondo bought it for 101,000 francs. Upon the death of the latter, his son, Count Isaac de Camondo, fell heir to it.

This clock, which is entirely of white marble, is provided with two revolving horizontal circles for indicating the hour. These circles are of enamel. Upon one of them are inscribed the hours and upon the other the minutes—an arrangement that was quite frequent in certain beautiful timepieces of the last century.

SKELETON CLOCKS.—At the end of the eighteenth century, and during the first years of the nineteenth, certain skillful clockmakers endeavored to construct clocks of which the movement alone should constitute the decorative ensemble. The clockmaker's idea was to free himself from the concurrence of the worker in bronze, who had succeeded in substituting himself for him in the manufacture of cases and who had come to consider the movement as an accessory.

The name "skeleton" has been given to such clocks because their movement consists entirely of openwork.

In the eighteenth century the faces of these pieces, as well as their dials, without being handsome as a whole, offered a certain interest of detail. This part of the clock was often ornamented with bronzes chased and gilded and decorated with enamels.

The clock shown in Fig. 2 is found in one of the glass cases of the centennial exposition of bronze at the Esplanade des Invalides. It bears the mark of Cotteau, who was one of the most celebrated master enamelers of clocks of the epoch. Its dials have never been surpassed in brilliancy of coloring and fineness of design. Such clocks as this were made during the Revolutionary period. They possessed a decimal and duodecimal division of the dial. The most complicated ones indicated the decimal days and the months and the names that Fabre d'Eglantine gave them. Such is the clock that is found in the same glass case with the one that we represent herewith.

FIG. 4.—SKELETON WATCH.

In the nineteenth century these clocks lost their ornamented fronts and preserved thereafter only a simple disk of enamel with an open center. It was then that clockmakers, reveling in exaggeration, constructed extraordinary wheelwork, and accumulated difficulties at pleasure, with the pretension of overcoming them, although in this they in most cases failed. In order to increase the odd aspect of such movements, the latter were mounted upon a vertical plate of glass, so that the whole was completely exposed. We give an example of one in Fig. 3. This clock is found at the retrospective exposition of clockwork at the Esplanade des Invalides, and belongs to M. Borrel. The main wheel, which is of an exaggerated size, is, like the following ones, very finely cut. It is *the* skeleton par excellence.

Fig. 4 represents a piece belonging to M. Paul Garnier. It also is shown at the retrospective exposition, in a glass case containing some very remarkable watches and clocks belonging to the same gentleman. This watch, if it may be so called, is a curiosity of the first order. It belongs to the category of skeleton clocks of which we have just spoken. It was designed to be suspended from the neck by a chain, and was a sort of breastplate. It is formed of two plates of rock crystal set in a gold frame, and between which is placed the movement. The whole is 2·8 inches in height, 2·6 inches in width, and 0·2 of an inch in thickness. The wheelwork of the movement is arranged in the part forming the top of a lyre. It is wholly of openwork. The spring is concealed behind the dial, which, as may be seen, is placed in the body of the lyre. It consists of a large open disk of silver-plated copper, upon which are inscribed two periods of 12 hours (one of the hours of the day and the other of the hours of the night) which are indicated by a solid disk forming a back to the open one which carries the hours. This solid disk is finished in sky-blue enamel strewed with stars. At the two extremities of the diameter there is on one side a sun and on the other a star. It is these two stars that alternately mark the hours, since the disk that carries them is actuated by the movement. What determines the hours of the day and those of the night is the arrangement of one of the stars behind the eccentric part of the dial under which moves the enameled disk. In this eccentric part are observed small apertures, in one of which appears the day of the week, in another the day of the month, and in a third the month, and, finally, in the largest one, upon an immovable plate, is engraved the name of the person for whom the clock was made.

The movement is dated "Paris, 1806," and is signed "Bordier horloger." This name was quite common at the epoch.

This piece is more curious than pretty, and it certainly never had to give a running result better than the decorative result that we find it in to-day.—La Nature.

FIG. 1.—THE FALCONNET CLOCK.

FIG. 2.—ENAMELED SKELETON CLOCK.

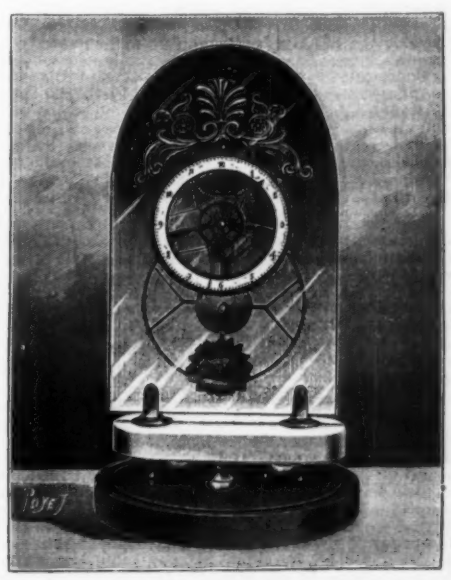


FIG. 3.—SKELETON CLOCK UPON GLASS.

THE PRODUCTION OF AN ARTIFICIAL LIGHT OF THE SAME CHARACTER AS DAYLIGHT.*

IT is a matter of common experience that many colors alter in appearance when seen by artificial light. The extent to which colors may vary under different illumination is perhaps not commonly known, but is well illustrated by the range of dyed cloths exhibited. Among other patterns, one which is green by daylight becomes red-brown by gaslight; a violet changes to purple; a gray to heliotrope; a shade of tan to a brick-red. Particularly striking is a pattern woven from specially died yarns, which appears a uniform green color by daylight, but which is figured by gaslight. Seen by the light of the electric arc, the patterns show similar but less marked changes.

It may be of interest to indicate briefly how such peculiar changes of color arise. The color of a body depends, in the first place, on the nature of the incident light. In monochromatic red light a red appears much the same as in daylight, but a yellow changes to red, a green is almost black, while blues and violets become red.

Gaslight shows a continuous spectrum from red to violet, but compared to daylight is of a strong orange color, due to an excess of rays in the red, orange, and yellow. It does not, however, necessarily result that all colors appear redder by gaslight. It is, indeed, well known that the majority of colors change little by gaslight. This is due to the adaptability of the eye; if the light becomes redder, the eye becomes less sensitive to red; if the light is deficient in green, the eye becomes more sensitive to green. Persons working by gaslight soon cease to notice its intense orange color. It results that a gray produced by mixture of black and white appears gray under any illumination, and simple colors such as reds, oranges, and some greens, giving light confined practically to one part of the spectrum, undergo little change.

Generally, however, the color of a body is due to a mixture of light from different parts of the spectrum. All violet colors are transparent, not only for violet but also for blue and red light; all blues transmit not only blue, violet, and green light, but also more or less red. Consequently, whenever a blue or violet is used in the production of what is called by artists a "tertiary" color, the general result is a color having bright bands in different parts of the spectrum. A mixture of red, blue and yellow to produce a neutral gray will show bright bands in the red and green—complementary colors, resulting in a proportion of white light. According to the exact position and intensity of these bands, the gray will become redder or greener, or may even remain unchanged by gaslight.

Generally, colors become redder under artificial light. This is due not only to the redder character of artificial light, as compared with daylight, but to the peculiar transparency of coloring matters for red light. Among reds and yellows, we have many theoretically perfect coloring matters, a perfect yellow having sharp

* Abstract of a paper read before Section A of the British Association at Bradford, 1900, by Arthur Dufton, M.A., B.Sc., and Walter M. Gardner, Bradford Technical College.

absorption in the violet and blue, and perfect transparency for green, yellow, orange and red rays. A perfect blue would be transparent for violet, blue and green, and opaque for the rest of the spectrum. Apparently such a blue can only be obtained by means of cupric salts. All other blue dyes and pigments we have examined agree in being more or less transparent for red light. Even greens transmit some red. This peculiar transparency of colors for red light is of primary importance in color-matching. All dyers know how persistent is the tendency to the development of red in the production of compound shades.

The need of an artificial light which should so closely resemble daylight as to show colors in their true relationship has long been felt by workers in color. At present the electric arc light is largely used for color work, but, as we have seen, it is far from satisfactory.

The peculiar character of daylight is due essentially to the modification produced by the atmosphere in the light from the sun. Light from a north sky as usually adopted for color work is deficient in red, orange and yellow rays, and consequently the light from a clear north sky is intensely blue.

Starting with the electric arc light as being nearest daylight in character, the authors attempted to imitate by direct absorption the effect produced by scattering in the atmosphere.

The light of an arc lamp consists of two distinct parts: (1) The light from the glowing carbons; (2) the light of the arc itself, characterized by its richness in violet rays. In lamps of the inclosed arc type the length of arc is increased, and consequently such lamps give a light richer in violet rays. Although arc lights vary somewhat in the proportion of violet light, they all agree in being richer than daylight in the amount of red, orange and yellow rays, compared with the amount of green and blue. Owing to the peculiar transparency of colors to red light already noticed, it is of primary importance that the proportion of red light should be carefully adjusted. Small variations in the amount of violet light are of minor importance, owing to the eye being less sensitive to such rays, and also because in mixing colors there is not the same tendency to develop a band of violet as we have seen occurs in the red, since yellow colors generally have complete absorption in the violet.

The required absorption of the less refrangible rays can be effected by means of blue cupric salts. A solution of copper sulphate shows strong absorption at the extreme red of the spectrum, the absorption extending with diminishing intensity into the green.

For practical purposes the light from the arc is modified by passage through pale blue glass colored by means of copper. This colored glass may conveniently take the form of a globe replacing the ordinary globe of the arc light.

[Continued from SUPPLEMENT, No. 1294, page 20742.]

THE AGE OF THE EARTH.*

By Prof. W. J. SOLLAS, D.Sc.

THE STRATIFIED SERIES.

THE course of events now becomes somewhat obscure, but sooner or later the familiar processes of denudation and the deposition started into activity, and have continued acting uninterruptedly ever since. The total maximum thickness of the sedimentary deposits, so far as I can discover, appears to amount to no less that 50 miles, made up as follows:

	Feet.	
Recent and Pleistocene	4,000	...Man.
Pliocene	5,000	...Pithecanthropus.
Miocene	9,000	
Oligocene	12,000	
Eocene	12,000	...Eutheria.
Cretaceous	14,000	
Jurassic	8,000	
Trias	13,000	...Mammals.
Permian	12,000	...Reptiles.
Carboniferous	24,000	...Amphibia.
Devonian	22,000	... Fish.
Silurian	15,000	
Ordovician	17,000	
Cambrian	16,000	...Invertebrata.
Keeweenawan	50,000	
Penokee	14,000	
Huronian	18,000	

Geologists, impressed with the tardy pace at which sediments appear to be accumulating at the present day, could not contemplate this colossal pile of strata without feeling that it spoke of an almost inconceivably long lapse of time. They were led to compare its duration with the distances which intervene between the heavenly bodies; but while some chose the distance of the nearest fixed star as their unit, others were content to measure the years in terms of miles from the sun.

EVOLUTION OF ORGANISMS.

The stratified rocks were eloquent of time, and not to the geologist alone; they appealed with equal force to the biologist. Accepting Darwin's explanation of the origin of species, the present rate at which form flows to form seemed so slow as almost to amount to immutability. How vast, then, must have been the period during which by slow degrees and innumerable stages the protozoon was transformed into the man! And if we turn to the stratified column, what do we find? Man, it is true, at the summit, the oldest fossiliferous rocks 34 miles lower down, and the fossils they contain already representing most of the great classes of the invertebrata, including crustacea and worms. Thus, the evolution of the vertebrata alone is known to have occupied a period represented by a thickness of 34 miles of sediment. How much greater, then, must have been the interval required for the elaboration of the whole organic world? The human mind, dwelling on such considerations as these, seems at times to have been affected by a sur-excitation of the imagination, and a consequent paralysis of the understanding, which led to a refusal to measure geological time by years at all, or to reckon by anything less than "eternities."

GEOLOGIC PERIODS OF TIME.

After the admirable address of your president last year, it might be thought needless for me to again enter into a consideration of this subject; it has been said, however, that the question of geological time is like the Djin in Arabian tales, and will irrepressibly come up again for discussion, however often it is disposed of. For my part I do not regard the question so despondingly, but rather hope that by persevering effort we may succeed in discovering the talisman by which we may compel the unwilling Djin into our service. How immeasurable would be the advance of our science could we but bring the chief events which it records into some relation with a standard of time?

Before proceeding to the discussion of estimates of time drawn from a study of stratified rocks, let us first consider those which have been already suggested by other data. These are as follows: 1. Time which has elapsed since the separation of the earth and moon, fifty-six millions of years, minimum estimate by Prof. G. H. Darwin. 2. Since the "consistentior status," twenty to forty millions (Lord Kelvin). 3. Since the condensation of the oceans, eighty to ninety millions, maximum estimate by Prof. J. Joly.

It may be at once observed that these estimates, although independent, are all of the same order of magnitude, and so far confirmatory of each other. Nor are they opposed to conclusions drawn from a study of stratified rocks; thus, Sir Archibald Geikie, in his address to this section last year, affirmed that, so far as these were concerned, one hundred millions of years might suffice for their formation. There is then very little to quarrel about, and our task is reduced to an attempt, by a little stretching and a little paring, to bring these various estimates into closer harmony.

Prof. Darwin's estimate is admittedly a minimum; the actual time, as he himself expressly states, "may have been much longer." Lord Kelvin's estimate, which he would make nearer twenty than forty millions, is founded on the assumption that since the period of the "consistentior status" the earth has cooled simply as a solid body, the transference of heat from within outward having been accomplished solely by conduction.*

It may be at once admitted that there is a large amount of truth in this assumption; there can be no possible doubt that the earth reacts toward forces applied for a short time as a solid body. Under the influence of the tides it behaves as though it possessed a rigidity approaching that of steel, and under sudden blows, such as those which give rise to earthquakes, with twice this rigidity, as Prof. Milne informs me. Astronomical considerations lead to the conclusion that its effective rigidity has not varied greatly for a long period of past time.

Still, while fully recognizing these facts, the geologist knows—we all know—that the crust of the earth is not altogether solid. The existence of volcanoes by itself suggests the contrary, and although the total amount of fluid material which is brought from the interior to the exterior of the earth by volcanic action may be, and certainly is, small—from data given by Prof. Penck I estimate it as equivalent to a layer of rock uniformly distributed two mm. thick per century—yet we have every reason to believe that volcanoes are but the superficial manifestation of far greater bodies of molten material which lie concealed beneath the ground. Even the wide areas of plutonic rock, which are sometimes exposed to view over a country that has suffered long-continued denudation, are merely the upper portion of more extensive masses which lie remote from view. The existence of molten material within the earth's crust naturally awakens a suspicion that the process of cooling has not been wholly by conduction, but also to some slight extent by convection, and to a still greater extent by the bodily migration of liquid lava from the deeper layers of the crust toward the surface.

The existence of local reservoirs of molten rock within the crust is even still more important in another connection, that is, in relation with the supposed "average rate of increase of temperature with descent below the ground." It is doubtful whether we have yet discovered a rate that in any useful sense can be spoken of as "average." The widely divergent views of different authorities as to the presumed value of this rate may well lead to reflection. The late Prof. Prestwich thought a rise of 1° F. for every 45 feet of descent below the zone of constant temperature best represented the average; Lord Kelvin in his earlier estimates has adopted a value of 1° F. for every 51 feet; the committee of this association appointed to investigate this question arrived at a rate of 1° F. for every 60 feet of descent; Mr. Clarence King has made calculations in which a rate of 1° F. for 72 feet is adopted; a re-investigation of recorded measurements would, I believe, lead to a rate of 1° F. in 80 or 90 feet as more closely approaching the mean. This would raise Lord Kelvin's estimate to nearly fifty millions of years.

When from these various averages we turn to the observations on which they are based, we encounter a surprising divergence of extremes from the mean; thus in the British Isles alone the rate varies from 1° F. in 34 feet to 1° F. in 92 feet, or in one case to 1° F. in 130 feet. It has been suggested, and to some extent shown, that these irregularities may be connected with differences in conductivity of the rocks in which the observations were made, or to the circulation of underground water; but many cases exist which cannot be explained away in such a manner, but are suggestive of some deep-seated cause, such as the distribution of molten matter below the ground. Comparatively low rates of increase are found over Wales and in the province of Leinster, districts of relatively great stability, the remnants of an island that have in all probability stood above the sea ever since the close of the Silurian period. To the north of this, as we enter a region which was subject to volcanic disturbances during the Tertiary period, the rate increases.

It is obvious that in any attempt to estimate the rate at which the earth is cooling as a solid body, the disturbing influence of subterranean lakes of molten rock must as far as possible be eliminated; but this will not be affected by taking the accepted mean of observed rates of increase of temperature; such an average is merely a compromise, and a nearer approach to a correct result will possibly be attained by selecting some low rate of increase, provided it be based on accurate observations.

It is extremely doubtful whether an area such as the British Isles, which has so frequently been the theater of volcanic activity and other subterranean disturbance, is the best fitted to afford trustworthy results; the Archæan nucleus of a continent might be expected to afford surer indications. Unfortunately, the hidden treasures of the earth are seldom buried in these regions, and bore-holes in consequence have rarely been made in them. One exception is afforded by the copper-bearing district of Lake Superior, and in one case, that of the Calumet and Hecla mine, which is 4,580 feet in depth, the rate of increase, as determined by Prof. A. Agassiz, was 1° F. for every 223·7 feet. The Bohemian "horst" is a somewhat ancient part of Europe, and in the Przibram mines, which are sunk in it, the rate was 1° F. for every 126 feet of descent. In the light of these facts it would seem that geologists are by no means compelled to accept the supposed mean rate of increase of temperature with descent into the crust as affording a safe guide to the rate of cooling of a solid globe; and if the much slower rate of increase observed in the more ancient and more stable regions of the earth has the importance which is suggested for it, then Lord Kelvin's estimate of the date of the "consistentior status" may be pushed backward into a remoter past.

If, as we have reason to hope, Lord Kelvin's somewhat contracted period will yield to a little stretching, Prof. Joly's, on the other hand, may take some paring. His argument, broadly stated, is as follows: The ocean consisted at first of fresh water; it is now salt, and its saltness is due to the dissolved matter that is constantly being carried into it by rivers. If, then, we know the quantity of salt which the rivers bring down each year into the sea, it is easy to calculate how many years they have taken to supply the sea with all the salt it at present contains. For several reasons it is found necessary to restrict attention to one only of the elements contained in sea salt: this is sodium. The quantity of sodium delivered to the sea every year by rivers is about 160,000,000 tons; but the quantity of sodium which the sea contains is at least ninety millions of times greater than this. The period during which rivers have been carrying sodium into the sea must therefore be about ninety millions of years. Nothing could be simpler; there is no serious flaw in the method, and Prof. Joly's treatment of the subject is admirable in every way; but of course in calculations such as this everything depends on the accuracy of the data, which we may therefore proceed to discuss. Prof. Joly's estimate of the amount of sodium in the ocean may be accepted as sufficiently near the truth for all practical purposes. We may therefore pass on to the other factor, the annual contribution of sodium by river water. Here there is more room for error. Two quantities must be ascertained: one the quantity of water which the rivers of the world carry into the sea, the other the quantity or proportion of sodium present in this water. The total volume of water discharged by rivers into the ocean is estimated by Sir John Murray as 6,524 cubic miles. The estimate being based on observations of thirty-three great rivers, although only approximate, it is no doubt sufficiently exact; at all events, such alterations as it is likely to undergo will not greatly affect the final result. When, however, we pass to the last quantity to be determined, the chemical composition of average river water, we find that only a very rough estimate is possible, and this is the more unfortunate because changes in this may very materially affect our conclusions. The total quantity of river water discharged into the sea is, as we have stated, 6,524 cubic miles. The average composition of this water is deduced from analyses of nineteen great rivers, which altogether discharge only 488 cubic miles, or 7·25 per cent. of the whole. The danger in using this estimate is twofold: in the first place, 7·25 is too small a fraction from which to argue to the remaining 92·75 per cent., and, next, the rivers which furnish it are selected rivers, i. e., they are all of large size. The effect of this is that the drainage of the volcanic regions of the earth is not sufficiently represented, and it is precisely this drainage which is richest in sodium salts. The lavas and ashes of active volcanoes rapidly disintegrate under the energetic action of various acid gases, and among volcanic exhalations sodium chloride has been especially noticed as abundant. Consequently we find that while the proportion of sodium in Prof. Joly's average river water is only 5·73 per million, in the rivers of the volcanic island of Hawaii it rises to 24·5 per million (Walter Maxwell, "Lavas and Soils of the Hawaiian Islands," p. 170). No doubt the area occupied by volcanoes is trifling compared with the remaining land surface. On the other hand, the majority of volcanoes are situated in regions of copious rainfall, of which they receive a full share owing to their mountainous form. Much of the fallen rain percolates through the porous material of the cone, and, richly charged with alkalies, finds its way by underground passages toward the sea, into which it sometimes discharges by submarine springs.

Again, several considerations lead to the belief that the supply of sodium to the ocean has proceeded, not at a uniform, but at a gradually diminishing rate. The rate of increase of temperature with descent into the crust has continuously diminished with the flow of time, and this must have had its influence on the temperature of springs, which furnish an important contribution to river water. The significance of this consideration may be judged from the composition of the water of geysers. Thus Geyser, in Iceland, contains 884 parts of sodium per million, or nearly 160 times as much as Sir John Murray estimates is present in average river water. A mean of the analyses of six geysers in different parts of the world gives 400 parts of sodium per million, existing partly as chloride, but also as sulphate and carbonate.

It should not be overlooked that the present is a calm and quiet epoch in the earth's history, following after a time of fiery activity. More than once, indeed, has the past been distinguished by unusual manifestations of volcanic energy, and these must have had some effect upon the supply of sodium to the ocean. Finally, although the existing ocean water has apparently but slight effect in corroding the rocks which form its bed, yet it certainly was not inert when its temperature was not far removed from the critical point. Water begins to exert a powerful destructive action on silicates at a temperature of 180° C., and during the interval occupied in cooling from 370° to 180° C. a

*Opening address by the President of the Section of Geology, British Association.

*The heat thus brought to the surface would amount to one-seventeenth of that conveyed by conduction.

considerable quantity of sodium may have entered into solution.

A review of the facts before us seems to render some reduction in Dr. Joly's estimate imperative. A precise assessment is impossible, but I should be inclined myself to take off some ten or thirty millions of years.

We may next take the evidence of the stratified rocks. Their total maximum thickness is, as we have seen, 265,000 feet, and consequently if they accumulated at the rate of one foot in a century, as evidence seems to suggest, more than twenty-six millions of years must have elapsed during their formation.

OBSCURE CHAPTER IN THE EARTH'S HISTORY.

Before discussing the validity of the argument on which this last result depends, let us consider how far it harmonizes with previous ones. It is consistent with Lord Kelvin's and Prof. Darwin's, but how does it accord with Prof. Joly's? Supposing we reduce his estimate to fifty-five millions; what was the earth doing during the interval between the period of 55,000,000 of years ago and that of only 26,500,000 of years ago, when, it is presumed, sedimentary rocks commenced to be formed? Hitherto we have been able to reason on probabilities; now we enter the dreary region of possibilities, and open that obscure chapter in the history of the earth previously hinted at. For there are many possible answers to this question. In the first place, the evidence of the stratified rocks may have been wrongly interpreted, and two or three times the amount of time we have demanded may have been consumed in their formation. This is a very obvious possibility, yet again our estimate concerning these rocks may be correct, but we may have erroneously omitted to take into account certain portions of the Archæan complex, which may represent primitive sedimentary rocks, formed under exceptional conditions, and subsequently transformed under the influence of the internal heat of the earth. This, I think, would be Prof. Bonney's view. Finally, Lord Kelvin has argued that the life of the sun as a luminous star is even more briefly limited than that of our oceans. In such a case, if our oceans were formed 55,000,000 of years ago, it is possible that after a short existence as almost boiling water they grew colder and colder, till they became covered with thick ice, and moved only in obedience to the tides. The earth, frozen and dark, except for the red glow of her volcanoes, waited the coming of the sun, and it was not till his growing splendor had banished the long night that the cheerful sound of running waters was heard again in our midst. Then the work of denudation and deposition seriously recommenced, not to cease till the life of the sun is spent. Thus the thickness of the stratified series may be a measure rather of the duration of sunlight than of the period which has elapsed since the first formation of the ocean. It may have been so—we cannot tell—but it may be fairly urged that we know less of the origin, history, and constitution of the sun than of the earth itself, and that, for aught we can say to the contrary, the sun may have been shining on the just-formed ocean as cheerfully as he shines to-day.

TIME REQUIRED FOR THE EVOLUTION OF THE LIVING WORLD.

But, it will be asked, how far does a period of 26,000,000 satisfy the demands of biology? Speaking only for myself, although I am aware that eminent biologists are not wanting who share this opinion, I answer, Amply. But it will be exclaimed, Surely there are "comparisons in things." Look at Egypt, where more than 4,000 years since the same species of man and animals lived and flourished as to-day. Examine the frescoes and study the living procession of familiar forms they so faithfully portray, and then tell us, how comes it about that from changes so slow as to be inappreciable in the lapse of forty centuries you propose to build up the whole organic world in the course of a mere 26,000,000 of years? To all which we might reply that even changeless Egypt presents us with at least one change—the features of the ruling race are to-day not quite the same as those of the Pharaohs. But putting this on one side, the admitted constancy in some few common forms proves very little, for so long as the environment remains the same natural selection will conserve the type, and, so far as we are able to judge, condition in Egypt have remained remarkably constant for a long period.

Change the conditions, and the resulting modification of the species becomes manifest enough; and in this connection it is only necessary to recall the remarkable mutations observed and recorded by Prof. Weldon in the case of the crabs in Plymouth Harbor. In response to increasing turbidity of the sea water, these crabs have undergone or are undergoing a change in the relative dimensions of the carapace, which is persistent, in one direction, and rapid enough to be determined by measurements made at intervals of a few years.

Again, animals do not all change their characters at the same rate; some are stable, in spite of changing conditions, and these have been cited to prove that none of the periods we look upon as probable, not 25,000,000, not 100,000,000 of years, scarce any period short of eternity, is sufficient to account for the evolution of the living world. If the little tongue-shell, Lingula, has endured with next to no perceptible change from the Cambrian down to the present day, how long, it is sometimes inquired, would it require for the evolution of the rest of the animal kingdom? The reply is simple: the cases are dissimilar, and the same record which assures us of the persistency of the Lingula tells us in language equally emphatic of the course of evolution which has led from the lower organisms upward to man. In recent and Pleistocene deposits the relics of man are plentiful: in the latest Pliocene they have disappeared, and we encounter the remarkable form Pithecanthropus; as we descend into the Tertiary systems the higher mammals are met with, always sinking lower and lower in the scale of organization as they occur deeper in the series, till in the Mesozoic deposits they have entirely disappeared, and their place is taken by the lower mammals, a feeble folk, offering little promise of the future they were to inherit. Still lower, and even these are gone; and in the Permian we encounter reptiles and the ancestors of reptiles, probably ancestors of mammals too; then into the Carboniferous, where we find amphibians, but no true reptiles; and next into the Devonian, where fish predominate, after making their earliest appearance at the close of the Silurian times; thence downward, and the vertebrata are no more found—we trace the evolution of the invertebrata alone. Thus the orderly procession of organic forms follow in precisely the true phylogenetic sequence; invertebrata first, then vertebrates, at first fish, then amphibia, next reptiles, soon after mammals, of the lowlier kinds first, of the higher later, and these in increasing complexity of structure till we finally arrive at man himself. While the living world was thus unfolding into new and nobler forms, the immutable Lingula simply perpetuated its kind. To select it, or other species equally sluggish, as the sole measure of the rate of biologic change would seem as strange a proceeding as to confound the swiftness of a river with the stagnation of the pools that lie beside its banks. It is occasionally objected that the story we have drawn from the palæontological record is mere myth or is founded only on negative evidence. Cavils of this kind prove a double misapprehension, partly as to the facts, partly as to the value of negative evidence, which may be as good in its way as any other kind of evidence.

Geologists are not unaware of the pitfalls which beset negative evidence, and they do not conclude from the absence of fossils in the rocks which underlie the Cambrian that pre-Cambrian periods were devoid of life; on the contrary, they are fully persuaded that the seas of those times were teeming with a rich variety of invertebrate forms. How is it that, with the exception of some few species found in beds immediately underlying the Cambrian, these have left behind no vestige of their existence? The explanation does not lie in the nature of the sediments, which are not unfitted for the preservation of fossils, nor in the composition of the then existing sea water, which may have contained quite as much calcium carbonate as occurs in our present oceans; and the only plausible supposition would appear to be that the organisms of that time had not passed beyond the stage now represented by the larvæ of existing invertebrata, and consequently were either unprovided with skeletons, or at all events with skeletons durable enough for preservation. If so, the history of the earlier stages of the evolution of the invertebrata will receive no light from palæontology; and no direct answer can be expected to the question whether, 18,000,000 or 19,000,000 of years being taken as sufficient for the evolution of the vertebrata, the remaining available 8,000,000 would provide for that of the invertebrate classes which are represented in the lowest Cambrian deposits. On *à priori* grounds there would appear to be no reason why it should not. If 2,000,000 of years afforded time enough for the conversion of fish into amphibians, a similar period should suffice for the evolution of trilobites from annelids, or of annelids from trochospheres. The step from gastrulas to trochospheres might be accomplished in another 2,000,000, and 2,000,000 more would take us from gastrulas through morulas to protozoa.

As things stand, biologists can have nothing to say either for or against such a conclusion; they are not at present in a position to offer independent evidence; nor can they hope to be so until they have vastly extended those promising investigations which they are only now beginning to make into the rate of the variation of species.

(To be continued.)

FRENCH CULTIVATION WITH CHEMICAL MANURES.

I. CEREALS AND POTATOES.

THE ceaseless beneficial operations of the Free Agricultural Syndicate of the Marne are well known. We have before us the report of M. Ponsard, president of the society, relative to the experiments undertaken during the past year.

These relate principally to the employment of sodium nitrate and its compounds with other manures for the regeneration of natural meadows for cereals, potatoes, and the vine. They were well prepared and conducted, and the results should stimulate our readers at other points to improve their cultivation.

For the experiments there were set apart 20 hectares of meadows divided into lots of 50 ares; 6 hectares of vine lands, and various parcels designed for wheat, rye, barley, oats and potatoes.*

We will notice first those conducted on the natural meadows.

In February and March, the manures were spread, but an almost interminable rain supervened. The herbaceous vegetation was developed luxuriantly at all points. The chemicals, diluted, were drawn into the soil and could not produce their ordinary effect. The rains did not cease for three months. The crop of hay was everywhere extraordinarily abundant. Nevertheless, the effect of the sodium nitrate was quite noticeable.

These results are furnished by M. Ponsard:

At Pogny, in a place called Yverseulx, a piece of meadow of 1·60 hectares, the increased value, as compared with the previous year, was 30 francs the hectare, at a cost of 20 francs.

In the same territory a lot of 4 hectares gave a similar result. At Pogny four lots of communal meadow were benefited to the extent of 34 francs per hectare. At Togny, on the communal meadow, the result was the same. At Cheppes and at Chaussée, 4 hectares, treated with the nitrate, were equally benefited; and the decided action of the nitrate on leguminous plants was observed—an action which had been denied by some operators.

In this connection must be mentioned the results secured by M. Masson, Mayor of Vonciennes, in his meadows at Cheppes. In April he scattered 100 kilogrammes of nitrate and 150 kilogrammes of plaster over the central portion of a surface of 2 hectares 40 ares. One month later the grass was greener and closer than that of the surrounding portions. On June 24, the difference was so great that the peasants came expressly to admire the fine vegetation. They said that the meadow of the experimenter was "the most beautiful" in all the territory of the commune. "The path of the machine," states M. Masson, "could be distinctly seen in the vegetation;" and he adds: "I made a comparison with an adjoining piece, and the grass was at least 0·20 meter higher. The portion not manured yielded 3,400 kilogrammes to the hectare. The portion having the nitrate yielded 5,000 kilogrammes to the hectare, a difference of 1,600 kilogrammes at 30 francs per 520 kilogrammes, or 90 francs per hectare. I expended 22 francs for nitrate and 5 francs for plaster, making 27 francs to deduct from the 90 francs, leaving 63 francs of clear benefit per hectare."

If it is remembered that the yield of these meadows is never very heavy, an increase of 63 francs per hectare is remarkably significant. It produced such an impression on the peasants of Cheppes that they are profiting by the excellent lesson.

The report notes the following interesting operation:

"In Champagne, the uncultivated lands are called 'peloux.' We sowed 30 ares with nitrate, at the rate of 150 kilogrammes to the hectare. Vegetation received an impetus and allowed of harvesting hay with the scythe, where only sheep had been able to crop the meager grass growing naturally on the arid soil."

With the culture of cereals, the experiments of the syndicate were not less satisfactory.

At Omey, a field of 30 ares was sowed with Rietti wheat in the previous autumn. The land had not received any farm manure. In April, an application of nitrate, at the rate of 150 kilogrammes to the hectare, was made. The vegetation was vigorous; the yield, 20 quintals to the hectare.

At Pogny, 40 hectares of meadow lands were sowed in February with Chinese hybrid wheat. After the plants appeared, they received a covering of 150 kilogrammes of sodium nitrate. Up to the end of June the vegetation left nothing to be desired. But a drought followed, affecting the growth, and the product was only 12 quintals to the hectare. This return was still remunerative, considering the condition of the soil. In the same tract, a field of autumn wheat ran along on one of the extremities of a piece bordered with large poplars. The roots of these trees had almost arrested vegetation. A strip of 6 meters in breadth was remarked for its almost complete exhaustion. Without notifying the owner, the agent of the syndicate scattered sodium nitrate over this portion. Eight days afterward the vegetation was strong, and at the time of harvesting very little difference could be noticed between the two parts of the field.

At Vonciennes, a parcel of about 25 ares was sowed in February with spring wheat of the dark Platanielle variety of Nice, enriched by a mixture of sodium nitrate and of superphosphate. The result was excellent; the yield of wheat being 20 quintals to the hectare.

The experiments with barley, notably with the Henna variety, were similarly successful, there being an important improvement from an application of 155 kilogrammes of sodium nitrate to the hectare.

For oats, the syndicate tried lands deemed of no value, which had lain uncultivated. By the application of 200 kilogrammes of sodium nitrate, a return of 20 hectoliters of oats was obtained.

With reference to rye, it is necessary to state that generally in the Champagne country lime superphosphate is employed advantageously at the rate of 250 to 300 kilogrammes per hectare. Since the employment of chemical manures, production has doubled. The syndicate decided to try the nitrate, and obtained a yield equivalent to that procured by the superphosphates.

Finally, the experiments made with potatoes have special importance. The varieties studied were the Aspasia, the Beauvais Institute, the Fontenay Belle, the Riesen, the Juli de Paulsen, and the Bep's Hero. They were planted in the experimental fields of the syndicate situated at Vonciennes, and could not have behaved better. The land which had not received any farm manure was enriched with the following chemical products: 200 kilogrammes of lime superphosphates and 100 kilogrammes of potassium chloride before the sowing; 150 kilogrammes of nitrate when the plants had reached a height of 20 centimeters; and 200 kilogrammes of ferric sulphate at the appearance of the first flower buds as a preventive against disease. The returns were in marked contrast with those of the lands treated with the farm manure, which suffered from disease. The yield of the syndicate varied, according to the variety, from 15,000 to 30,000 kilogrammes.

II. THE VINE.

Having spoken of the magnificent results in the cultivation of cereals and potatoes on meadow lands with the judicious employment of sodium nitrate and lime superphosphates, we will notice the results of trials with the same fertilizing materials in certain vineyards of the Department of the Marne.

These were undertaken in concert with the Free Agricultural Syndicate of the Marne by four experienced vine growers—M. Lesecq, of Mareuil-sur-Ay; the Abbé Bour, Superintendent of the Orphanage of the Borde at Mareuil, near Epernay; M. Ulysse Masson, Mayor of Vonciennes; and M. Peuchot, of Changy.

On the road from Mareuil to Visseuil, M. Lesecq has a vineyard of about 45 ares, planted in 1893 on the site of an old orchard, a portion of which was in bad condition with symptoms of chlorosis. Not having been able to counteract the evil with ferric sulphate alone, he had the idea, in 1895, to incorporate sodium nitrate with that remedy. He used ferric sulphate in the proportion of 600 to 700 kilogrammes, and sodium nitrate in the proportion of 125 to 150 kilogrammes per hectare. The whole was well mixed, scattered broadcast, and spaded in.

The land appearing sufficiently enriched by compost and ashes, he did not add superphosphates or potassium manures.

"Unfortunately," he says, "the mixture was scattered over the whole of the vineyard, although I had given directions to leave for comparison the upper portion, where the vegetation was in usual condition. Hence the growth was irregular, which was obviated with great trouble by repeated pinchings. But the chlorosis disappeared the last year and the vintage was very fine. The clusters were above the usual size."

The Abbé Bour had the previous year sprinkled a sufficient quantity of nitrate over a first lot and de-

* An are is 100 square meters, or nearly one rood (0·988); a hectare is 10,000 square meters, about 2½ acres (2·471). The hectoliter, occurring hereafter in the article, is 100 liters, about 22 gallons or 2¾ bushels (22·0066 gallons, 2·7512 bushels); a kilogramme (1,000 grammes) is about 2¼ pounds avoirdupois (2·2055); a centimeter is 0·01 of a meter, about 0·4 of an inch (0·3937).—TRANS.

posited it at each stock in a second lot. The last year he applied no enriching material in the second lot, and yet the yield was almost as good as in the portion treated with superphosphate. The effect of the nitrate evidently continued.

His experiments showed not only the special influence of the sodium nitrate, but also the high value of superphosphates in the development of the vineyard and its abundant fruitage.

According to the letter of the Abbé to the syndicate, he made use of superphosphate on the portion on which the nitrate had been sprinkled the year before, and on other land which had received nothing whatever. "The effect was prodigious. On every vine about fifteen fine clusters could be found, while the vineyards of the neighborhood yielded only five or six. Certain stocks bore 25 or 30 clusters, especially in the part which received the superphosphate this year and the nitrate the preceding year."

In view of this unaccustomed production and in order to appreciate the strong influence of the nitrate and superphosphate used separately or in mixture, it must be remarked that the vines left for comparison, and which consequently had not been treated with chemical manures, were much less productive; yet the manure of the farm had not been spared.

To these instructive lessons another quite as valuable can be added. The Abbé Bour, in the course of his experiments, was able to demonstrate the good curative results afforded by ferric sulphate. For several years a notable part of the vineyards of the Orphanage were diseased; yielding leaves, but very few grapes. Before spading, it was necessary to scatter a considerable quantity of ferric sulphate. The same year the vines recovered from their chlorotic tendency and yielded a light fruitage; last year the vintage was normal.

M. Masson writes as follows: "I have continued my experiments on the effect of sodium nitrate applied in general over the vineyards. The vegetation was magnificent and we hoped for an abundant yield, when the oidium made its appearance. Occupied with the care of the wheat harvest, I was not able to give attention to it immediately, and the vineyard suffered in consequence. I cannot, therefore, give precise figures; but I can say that the sodium nitrate was very fertilizing, and I shall continue to make use of it.

34 hectoliters to the hectare. I ought to call attention to the astonishing action of sodium nitrate on a vineyard completely exhausted. We purchased in 1898 a parcel of 8 acres bordering on the Etelle vineyard. This sale was made in the course of a judicial liquidation. The vineyard had been virtually abandoned for a long time. It was in such bad condition that the vine growers present asked: 'What can you do with that?' Only ordinary care was given to this lot. Sodium nitrate, to the extent of 250 kilogrammes per hectare, was applied twice, before and after the tillage. In July the impoverished vineyard was so vigorous that it could not be distinguished in appearance. It yielded an excellent white wine, which was sold for 50 francs the hectoliter to Champagne merchants. This fact, familiar to the vine growers throughout the Champagne country generally, attests the powerful action of sodium nitrate and requires no comment."

It would be difficult to find more decisive testimony, especially when we remember that the protracted rains of the spring were a great drawback, lessening the effects of the sodium nitrate, the superphosphates, the ferric sulphate and other chemical manures.

These reports ought to contribute decidedly to the improved cultivation of the vine and to scientific agriculture in general.—Translated from Le Phosphate.

Fig. 1.—GENERAL VIEW OF ROCHET CAR.

THE ROCHET MOTOR CAR.

Since the Rochet car was first put on the market, the most notable change is the placing of the engine under a bonnet in the fore part of the frame instead of at the rear. Fig. 8 shows the frame of the latest type of vehicle, complete with motor and transmission gear. This is so arranged that any desired form of carriage body may be mounted on it, and secured thereto by bolts. Fig. 1 shows the "due tonneau" style of body, with seating accommodation for six persons, but any other may readily and quickly be substituted for it. The frame is constructed from cold-drawn steel tubing with brazed joints, and is very rigid. All of its members are in internal communication, and it is made to serve as an auxiliary cooler for the cylinder jacket water. Two semi-elliptic springs in the rear and a transverse elliptic spring in front support the frame on the axles.

The Rochet motor, says The Motor Car Journal, to which we are indebted for the engraving and article, is an adaptation of the Daimler engine, but it embodies a considerable number of improvements in the details of its construction. It is shown in Figs. 3 and 4, and has two cylinders, developing 6 or 8 horse power, according to size. Some vehicles have two of these motors on one shaft, which gives them 12 or 16 horse power. The two cylinders are cast in one piece and bolted to the crank case. All the moving parts, save the levers acting on the exhaust valves, are inclosed. The crank case has the usual splash lubrication, and a glass set in its side enables the operator to observe the level of the oil. The governor is within the case, *J*, and the starting crank is worked from the front end of the vehicle. The cover, *B*, incloses a commutator to distribute the current for the spark, first to one and then to the other cylinder, electrical ignition being now employed.

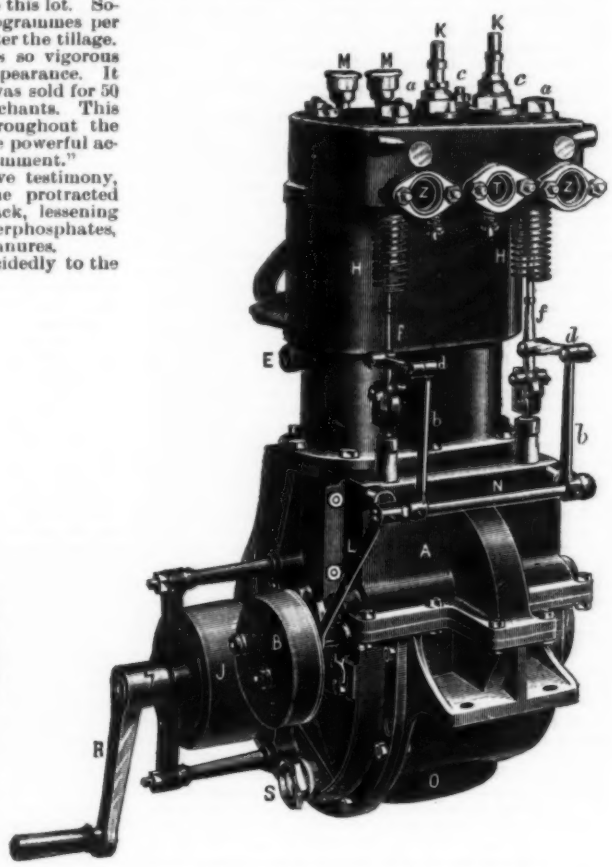


Fig. 3.—VIEW OF ROCHET MOTOR.

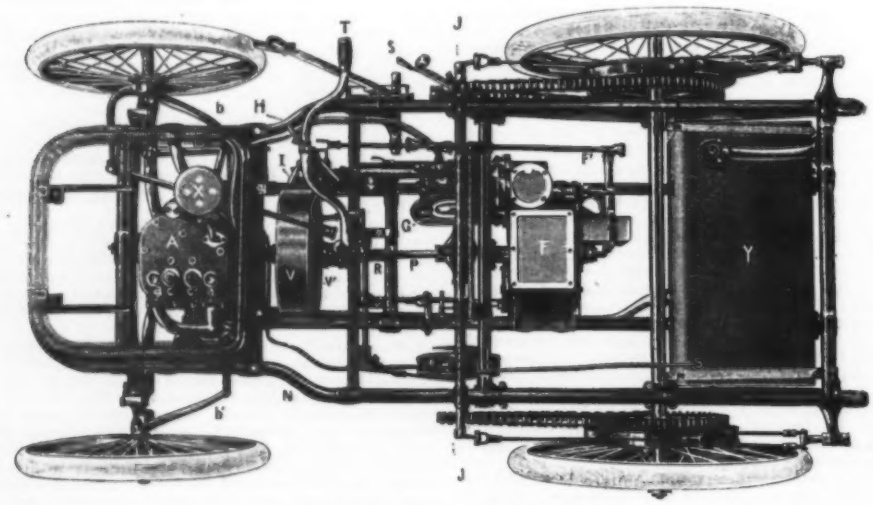


Fig. 2.—PLAN OF FRAME OF ROCHET CAR.

The valve box is cast in one piece with the head. The fresh mixture enters at *T* and passes to one or the other cylinder, while the exhaust gases pass out at *Z Z*. On top of the valve box are four screwed plugs, *a a c c*, which permit immediate access to the valves without dismounting the cylinder head; a meritorious feature. The two plugs, *c c*, over the inlet valves are formed to receive the sparking plugs, *K K*. Two cups, *M M*, on the cylinder head are provided for the introduction of a few drops of petrol, when starting, to dissolve any gummy oil that may have clogged the piston rings. The governor is set to permit a normal speed of 750 revolutions per minute. The cranks are set opposite to minimize vibration. The speed of the motor is controlled by causing one or both of the exhaust cam rollers to run off from thin cams on to adjacent circular cams, thereby putting one or both of the exhaust valves out of action. The air supply to the carburetor, which is of the constant level type, is warmed by passing around the exhaust pipe, and the mixture is diluted by an adjustable opening on its way to the motor. A small screwed plug at the base of the carburetor permits of draining the latter of stale petrol, and also of lowering the level in case the apparatus becomes "flooded" by non-operation of the float. The exhaust valves are operated from a secondary or cam shaft,

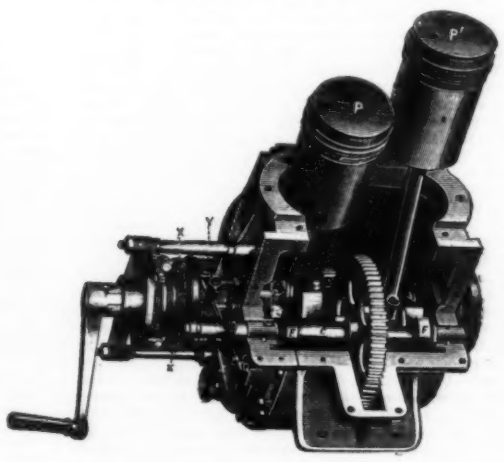


Fig. 4.—SECTIONAL VIEW OF ROCHET MOTOR.

M. Puchot, of Changy, in the arondissement of Vitry-le-François, is more emphatic:

"I have continued the employment of sodium nitrate, which I have used with success for many years. Our vineyards of Terme-au-Loup, of Etelle and of Tomeux twice received 200 kilogrammes of sodium nitrate per hectare; the growth was splendid. Two applications of the Burgundy mixture and two sulphurings secured them from attacks of mildew and the oidium. The vintage answered all our expectations; it exceeded

parallel with the crank shaft and geared to it by spur gears in the ratio of 1:2. The piece transmitting the push from the cam to the valve stem consists of two parts, the lower sliding rod, which has attached to it the roller, rolling on the cam, and the upper part, *f*, which is hinged to the lower part. A spring, acting through a pin on the projection of the lever, *f*, ordinarily holds it in line with the part to which it is hinged. The lever, *b*, pivoted from a support fastened to the crank-case, connects to the rod, *f*,

by means of a link, *d*. On the same shaft with lever, *b*, is another lever, which carries a roller at its lower end. This roller can be moved sideways on its shaft, and by this motion it is brought successively into contact with two cams on the cam shaft. These cams, through the intermediary of levers, throw the rod, *f*, out of line with the part to which it is hinged, and thus make it miss the valve stem, when it is lifted by the exhaust cam. The shifting of the roller is effected by the centrifugal governor. The water circulation is maintained by a pump, a large radiating coil being also fitted in the fore part of the frame.

Four forward speeds, ranging from 5 up to 30 kilometers per hour, and a reverse motion are provided.

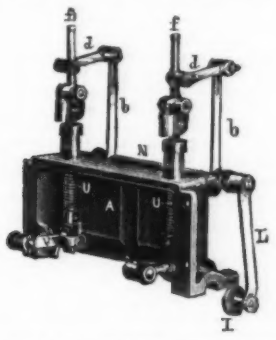
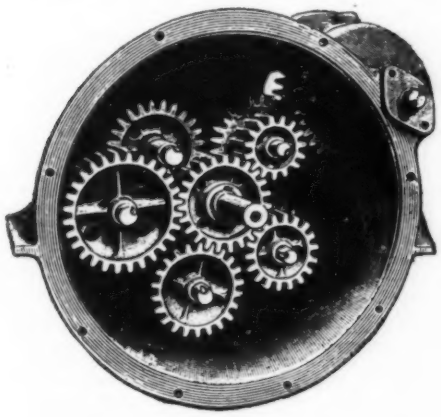
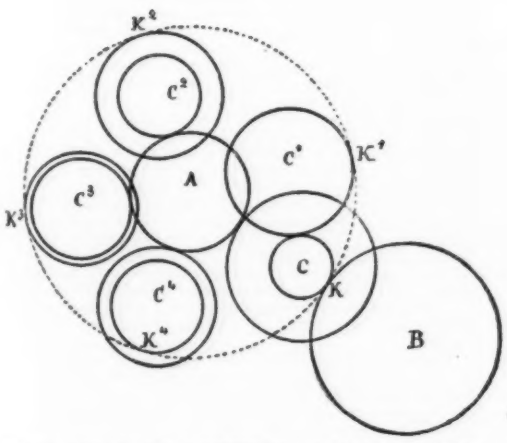


FIG. 5.—DETAILS OF EXHAUST VALVE GEAR OF ROCHET MOTOR.

As already stated, the motor is in front and the power is transmitted through the conical friction clutch, *V V'*, and the shaft, *P*, to the speed-changing gears in the case, *F* (Fig. 2). The change gears of the Rochet vehicle are of a somewhat different order from those usually found in French vehicles. The gear case with the gears in place is illustrated in Fig. 6. The central gear wheel, *A*, the shaft of which is seen protruding, is the driving gear and is concentric with the motor shaft. At the side of this wheel, running loosely on the motor shaft, is a disk, K^2, which on one face has projecting from it five short spindles, on which are mounted spur-wheels, K', K^2, K^3, K^4, K^5. The last four of these, while being each of a different diameter to give the necessary variation in speed, are continually in gear with the wheel, *A*, on the end of the motor shaft. The four wheels, K^2, K^3, K^4, K^5, each have rigidly connected to one of their sides small spur wheels, C^2, C^3, C^4, C. Under the action of a lever, the disk can be rolled round the wheel, *A*, until any one of these small spur wheels is brought into gear with the spur wheel, *B*, on an intermediary shaft parallel with the motor shaft. In this way any one of the four speeds can be quickly put in gear; for the backward motion, the spur wheel, K',





FIGS. 6 AND 7.—THE ROCHET VARIABLE SPEED GEAR.

driven through the train of wheels, $A\ K^5 C$, is brought into gear with *B*. From the intermediary the power is transmitted through a bevel wheel to a similar bevel wheel on the differential shaft (Figs. 2 and 9), and from the latter to the rear road wheels through the usual chain gear.

The vehicle is steered by a handle bar, *T* (Fig. 8), of which the left handle is bent upward while the right hand one is horizontal. The handle bar method of steering is claimed by the company to possess numerous advantages over the wheel; its management is more instinctive, its position indicates at once the angle of the front wheels, a thing of the first importance when maneuvering in close quarters. On the standard of the steering handle are two small handles working on notched segments. One of these acts on the governor of the motor and the other on the ignition, to vary the lead of the latter. Another and larger lever, *U*, acts on the speed-changing gears. To increase the speed the lever is moved forward, while a backward movement engages the lower gears successively and then reverses the vehicle.

At the driver's right is a brake lever, *W*, which tightens leather-lined brake bands on two drums, one on each of the hubs of the rear wheels, after first having, by the same movement, disengaged the motor at the cone clutch, *V*. This lever, *W*, is latched by a dog engaging a notched segment, so that the vehicle may be braked and the hand then employed for other purposes. There are two pedals, of which the left hand one first disengages the motor and by further movement applies a brake on the differential. The right-hand pedal acts in precisely the same manner as the lever, *W*, first disengaging the motor and then applying the rear wheel brakes. These brakes can, therefore, be applied either by hand or by foot, as most convenient. In an emergency both brakes can be applied at once. A third pedal, operated by the driver's heel, releases a latch governing the speed changes, and is always operated in connection with the lever, *U*. Cycle type wheels are fitted, these being shod with pneumatic tires. The Rochet car is made by La Compagnie Générale des Cycles et Automobiles, of Paris.

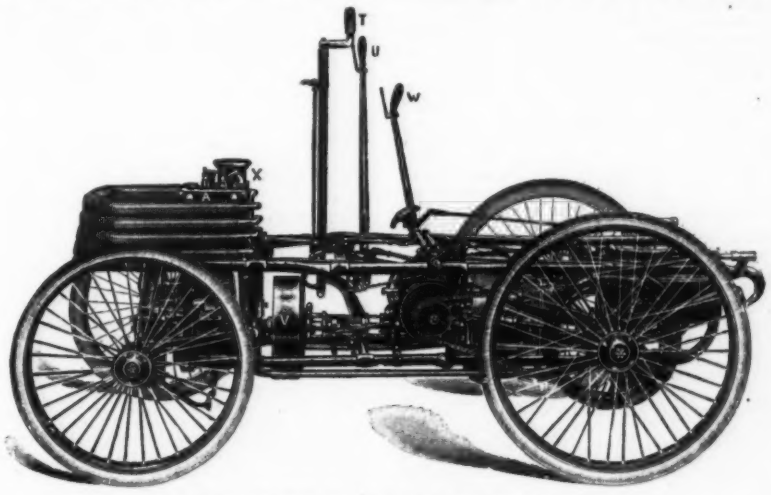


FIG. 8.—ELEVATION OF FRAME OF ROCHET CAR.

NEW PROCESS FOR THE PRODUCTION OF ELECTROLYTIC BATHS.

IN the following new process of the electrolysis of metals or metallic salts, the electrolytic effect from one pole to the other loses nothing of its strength, even after some time, so that a falling off in the action, which is bound to occur when, as heretofore, a current of at least two volts is employed, is entirely done away with. Under the action of a current of this strength the decomposition of the larger part of the water constituting the bath used to take place simultaneously with the migration of the ions; and the gases generated by the decomposition, especially hydrogen, exercised that deleterious action upon the metallic ions which manifests itself in that the deposits acquire a spongy or pulverulent character and a dull appearance. In the process described herewith the above drawbacks are fully obviated. The metallic deposits obtained are distinguished by adhering very permanently and firmly, possessing very great cohesion, being also very homogeneous and always exhibiting the handsomest luster.

The new process invented by Quintin Marino, of Brussels, is characteristic in that glycerine is exclusively employed as electrolytic fluid instead of water, in contradistinction to the formerly proposed method of adding a small quantity of glycerine to the bath.

Thus a liquid is made use of which is perfectly neutral and dissolves in water and alcohol in every ratio; furthermore it has the property of dissolving the larger part of those bodies which are likewise dissolved by water, and offering an exceedingly slight obstacle, owing to their great permeability, to the migration of the ions, so that it may be justly said that during the whole duration of the process no disturbing action sets in, and the entire electrolytic energy necessary to produce the results mentioned at the beginning is retained.

Again, if on the one hand an electrolytic bath mixed with glycerine presents the advantage that the electrolysis may take place with the use of a very weak current of slight tension, there is also, in consequence of the application of glycerine, a possibility, and without any disadvantage whatever, to utilize currents of very high tension, whereby a great acceleration of the work in all the electro-metallurgic applications of the process is obtained.

In the first place, the preparation of electrolytic baths with glycerine is very simple, especially if it is desired to manipulate the electrolysis of a number of metallic salts which are soluble in glycerine in certain proportions and at ordinary temperature, e. g., the salts of silver, zinc, copper, aluminium, lead, antimony, and arsenic. It suffices to dissolve these salts in the correct ratio in glycerine to obtain baths which are adapted without further treatment to be used for electrolytic purposes.

One hundred parts of glycerine will dissolve the following bodies at ordinary temperature, as indicated below:

Silver nitrate—solubility very great.	
Zinc chloride	50 parts.
Zinc sulphate	35 "
Zinc iodide	40 "
Copper sulphate	30 "
Copper acetate	10 "
Ferric sulphate	25 "
Ferrous acetate	16 "
Ferric tartrate	8 "
Ferric chloride—solubility very great.	
Ferrous iodide—solubility great.	
Alum	40 "
Lead acetate	20 "
Potassio-antimonio tartrate	550 "
Arsenious acid—solubility great.	

In case it is desired to obtain a stronger bath, it suffices to increase the temperature of the glycerine or of the mixture of glycerine and solvents.

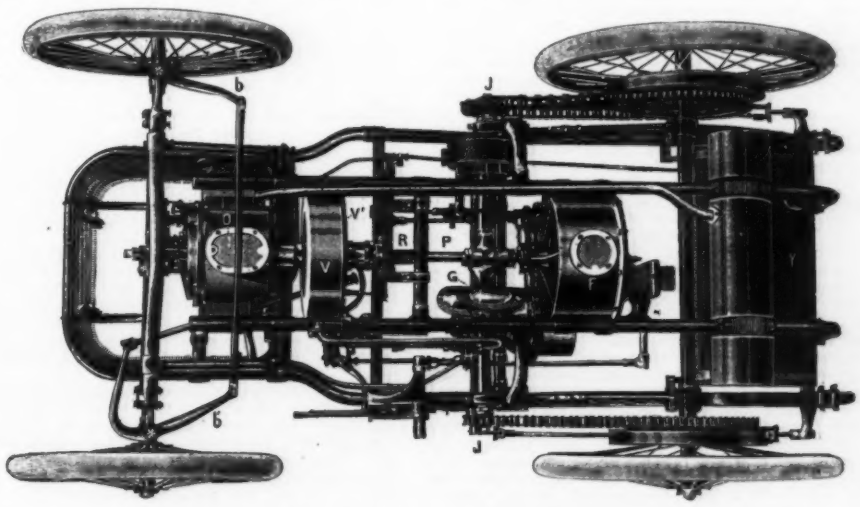


FIG. 9.—UNDERNEATH VIEW OF FRAME OF ROCHET CAR.

In the second place, where the salts of the other metals are not at all or little soluble in glycerine at an ordinary temperature, the circumstance is utilized that glycerine is capable of dissolving at a high temperature the bodies necessary for the formation of the electrolytic bath, without the glycerine undergoing a partial decomposition.

In the third place, as regards the metallic salts insoluble in glycerine, but soluble in other solvents, e. g., alcohol, caustic potash, and in the inorganic and or-

ganic acids, etc., these dissolvents are employed either alone or mixed with glycerine. In this manner the solution of most of the so-called insoluble minerals or chemical products is brought about in a simple and perfect manner.

The electric conductivity of the baths may be increased by adding to the finished electrolytes alkaline or ammoniacal salts, as well as organic acids, if same do not have an action on the salts of the metals to be precipitated.

The following are the salts and acids which enhance the conductivity of the bath, the proportions indicated showing the ratio in which these bodies dissolve in 100 parts of glycerine:

Sodium carbonate	98 parts.
Sodium borate	50 "
Ammonium carbonate	20 "
Ammonium chloride	20 "
Sodium bicarbonate	8 "
Potassium hydrate — solubility very great.	
Sodium hydrate — solubility very great.	
Sodium chloride	20 "
Barium chloride	10 "
Boracic acid	10 "
Sodium sulphide—solubility good.	

By this admixture of glycerine a favorable action is exercised upon the strength and quality of the precipitate or the electro-deposit in the same manner as the addition of 5 to 10 per cent. of sulphuric acid or concentrated nitric acid to the electrolyte, consisting of copper sulphate, is of advantage, not only the conductivity of the bath being increased thereby but also a very normal, not brittle, and non-crystalline precipitate being obtained with the use of very weak currents and large electrode surfaces.

As a matter of course, the composition of the electrolyte proper may be varied as desired, and according to the required final result. Only the substitution of glycerine for the water is essential. Besides, all those admixtures and additions which are capable of improving the results may be made, same as with ordinary electrodes.

Furthermore, admixtures of glycerine may be made when it is desired to form electrodes which are intended to yield deposits of metal alloys. For instance, to obtain an electrolyte which is capable of depositing a precipitate of brass, a copper bath is mixed with a zinc bath, the proportions varying according to the composition and color of metal desired. The same process is used to obtain a deposit of aluminium bronze or tin bronze, or of britannia metal. Finally, the same result can be obtained if soluble anodes are employed, consisting of the metallic alloys whose deposits are wanted.

The electrolytic baths, mixed with glycerine, are kept in order in the same manner as the ordinary baths, either an admixture of dissolved salts being made for this purpose or metallic anodes being employed. Also, the suitable minerals or chemical products may be arranged around the anodes or an addition of crystals of the respective metal salts takes place. It will be seen from the above that just as large a field remains open when the electrolysis is conducted with the use of glycerine as solvent as with the ordinary method, so that it is unnecessary to enter upon the various details of the different manipulations.—Journal der Goldschmiedekunst.

MORALS AND MANNERS OF THE JAPANESE AS VIEWED BY A NATIVE.*

A mistaken notion prevails among some foreign people that we have very low ideas of morals. I saw only the other day in a book that, in Japan, flowers have no fragrance, birds do not sing, and men have no morals and women no virtues. How could our nation have existed for twenty-five centuries without morals and without virtues? The very fact that we have lived as an independent nation and are still making progress ought, in itself, to refute such a statement. Only a few days ago I heard a gentleman say, "Out in Japan trees do not grow straight, but all crooked." I have seen such a tree; I have seen such trees on the Jersey coast, where the wind blows. This particular gentleman has, perhaps, never been to the sea coast in this country; but what they want is just to make some striking statement. They come with an idea that something must be very different in Japan; and whatever strikes them as a little singular goes into the diary. So many writers on Japan speak of our country as "topsy-turvydom": that everything is topsy-turvy there. Our carpenters, in using the plane, do not push from them, but pull toward them. The writer puts down in his note book, "Carpenters use their planes in an opposite direction from what an American carpenter would do." So in addressing letters: where, for instance, you say, "Mr. Inazo Nitobe, care of Friends' Select School, 140 No. Sixteenth Street, Philadelphia, Pennsylvania, United States," we, in addressing letters, write "United States, Pennsylvania, Philadelphia, Sixteenth Street No., 140, care of Friends' Select School, Nitobe Inazo Mr." and there end. "Here is evidence enough," they exclaim, "that everything is topsy-turvy"—everything: from comparatively little things they conclude that everything is topsy-turvy; and I heard of a good missionary lady who said the "work in Japan is so very hard: it is discouraging, because everything is so different: the cats have no tails, the dandelions are cream-colored, and the chickens have feathers growing the wrong way." If that good lady had devoted one-tenth of her religious zeal to the study of some primary book on natural science, she would have easily learned that there is a variety of cats that have very short tails (the Manx, among others); a variety of cream-colored dandelions; also a variety of chickens on which the feathers grow fuzzy and apparently the wrong way. She need not go as far off as Japan to find those things: she can find them anywhere in this country if she has her eyes open. Things in this country look to us topsy-turvy: a Japanese comes here and sees your carpenter work and says, "American carpenters work topsy-turvy, they push their planes away from them instead of toward them." We think our method is natural and yours unnatural, just as you think yours natural and ours unnatural. Writers on Japan try to exaggerate these differences; and intentionally, or otherwise, they make most remarkable statements. Take, for instance, that well-known book by Miss Duncan, "The Social Departure," and there is a picture of a card of a Japanese journalist. The card is printed upside down. She had this card, could not read the Japanese characters, and so had the center of the card printed upside down. Perhaps this position seemed to her more natural; but to our eyes it is evident that she made a mistake, and she wants to give her readers an idea that everything is this way, quite different from what it is in America. In the Frenchman Regamy's "Japan in Art and Industry," translated into English, page 15 bears a few scratches of Japanese characters and just below these characters what the author calls the equivalent in English. The translation says: "The population of Japan amounts to more than 45,000,000 souls." I tried to find where the original was. Just above this line of the Japanese characters were what was intended for the original; but with what little knowledge I have of the Japanese language I could not make that sense. As far as I could understand it, the Japanese said, "How do you do, madam?" About the middle of a small book by Mr. Von Bergen, entitled the "Story of Japan," there is a picture of an apothecary shop. The clerk is seated on a counter with ledger open before him; there are a number of boys working about the place making medicines; and all around this clerk are hung advertisements of different drugs. This author writes under the picture, "A Japanese Judge in his Court." It may be that in America an apothecary may well be chosen as supreme judge; but as a matter of fact, an apothecary rarely goes into the legal profession in our country; and, of course, the compounding of different harmful and harmless powders into beneficent pills may be a good training for any one to be a judge, who just puts down every sort of evidence and counter-evidence and concocts justice. I do not know whether those are meant for the reader or not; but it struck me as an example of exaggeration to prove something different between the manners and customs of Japan and those in this country.

Our manners and customs have continued for twenty-five centuries. I am not particularly proud that my country is old. I have great respect for new countries; but if manners and customs should have any justification in any way, that justification must be in experience; and there we are ahead of you. I have often seen a good-natured smile on the faces of foreigners when we say we eat with chop sticks. "Eat with chop sticks!" Oh, well, then, chop sticks are taken as a badge of barbarism, of lower civilization; but I assure you that we have been using chop sticks for more than twenty centuries—centuries and centuries before your forefathers ever thought of inventing a fork or a knife. And we find it very convenient and we won't give them up: we rather think of the use of spoons and forks as being for people who cannot manipulate chop sticks, but resort to spoons.

It is not safe to ridicule other countries' customs and manners. Few things struck me as so ridiculous as the band on your hat? What is the use of hat bands? It doesn't make you any better; it doesn't add warmth to the head; it does not make the head any cooler. Is that a decoration? Well, who invented it? And what are those two buttons on the back of your coat? I have, as yet, seen no reasonable explanation of it, except that they were used in holding up belts in those days when your ancestors used to wear swords. There must be some good ground for everything that exists; only, many of those grounds are lost in antiquity, and so with our customs. Every custom and every manner has its justifying reason.

Two things that I want particularly to emphasize are, first, the geographical influences upon our manners and morals; and, secondly, their historical background. Japan is only about three or four times the size of Pennsylvania—a very small country to boast of being an empire. It is only the size of the State of California, but it is a long country. We are neighbors: I don't know what you are going to do with the Philippine Islands, but I know something of the history of the Anglo-Saxon race, and whatever fell into their clutch rarely escaped; and the American civilization will very likely be imposed upon those people. We are distant from the Philippine Islands only about a few hundred miles and extend from 22° N. L. to 50° N. L., pretty near the latitude of Newfoundland; so you can imagine from the Philippine Islands to Newfoundland is a very long series of islands. Some say there are three million islands. I do not believe it. It depends on the definition of island. If a piece of rock is defined as an island, I think we may have three billions. Some say that there are two thousand islands. That, also, may be true; but any number will do. It is a long series of islands, and the climate is also very varied. "What is the climate of Japan?" Just as well might you ask, What is the climate of America? We have the climates of your New England, your Florida, and even of Porto Rico and Cuba. It is a mountainous country, everywhere are mountains. There is nothing to be compared with your prairies, and necessarily the farms are small: the peasantry must be content with a low standard of living.

All these things reflect on the morals and manners of the people. Our climate is very moist: rainfall is tremendous; and even when we have no rain, mists and fogs are very, very frequent. That shows itself in our art. You very often see in Japanese pictures little lines here and there. You don't know what they are—just lines; and you wonder what they can be. They show the mists that rise from the ground every morning, everywhere, and add beauty to the landscape. That you see everywhere. Then with it, very closely connected, is the moon. I do not mean that we have a particular kind of moon; neither do I mean that the moon shines every night in Japan. We have not gone so far; but some artist has told me that there must be a relation between the moisture of the atmosphere and the moon—something that makes the landscape look soft—a certain softening influence of Japanese sky must be attributed to the moisture and with it also to the light of the moon, which loses its brilliancy coming through the stratum of mist. Therefore, in our poetry, in our literature (that is to say, in our thoughts and in our sentiments), you see these mists and the moon most frequently; and here is another point to consider in the influence of geography on our morals and on our manners and sentiments.

Another interesting point connected with the moisture of our climate is the bathing custom. It is said that no people on the face of the earth is more fond of bathing than the Japanese. I don't know whether we evolved from some kind of fish; I am not evolutionist enough to give any proof; but we are very fond of bathing; the poorest peasant must bathe before he goes to bed. They work in their little irrigated rice fields knee-deep in mud. When they come home they must bathe. They have a large kettle, they boil water there, and one after another they go in and bathe. You think that won't make them very clean if so many people jump into the same tub, but it makes them clean because they just go into these tubs or rather into the kettle and warm themselves and come out of the tub and then scrub and pour hot water over them; and when they get clean, they get into the tub again and warm themselves, so the water is not so dirty. So in the cities you see bath houses almost in every square, in every block, and people go there and bathe and they pay the enormous amount of one cent (children pay 3/4c.) and they can stay there as long as they want. They can scrub as much as they want, they can skin off, if they want to. It is a social study to go there and see those people. Hundreds of people go there, and a very careful chemical analysis has shown that the water is not so dirty as you would imagine from merely hearing that hundreds of people went into the same bathtub, which, by the way, is large enough to accommodate ten people at once.

That was not my main point. The point that I wanted to make was that this bath that the Japanese take is quite warm. It is about 120° F., if that is warm enough for you, and so when the people stick themselves there for a few minutes and come out they are red all over; the brown skin of the Japanese turns perfectly red, from the water at 120° F., and foreign doctors, American doctors and German doctors, come and say, "No, it is a barbarous custom; it is against physiology; hygiene doesn't allow that;" and so we are told that the temperature of the bath must not exceed—I forget what: I think it is 90°, or something like that, and you wonder how people can get into such hot baths, while we wonder, also, how you can endure such lukewarm baths as you take. It has been found that a moist climate makes it necessary for bathers to take baths hot; and Americans, Englishmen, Germans and any other foreigners, who come to Japan and seem at first to despise the high temperature of our baths, find, in the course of a few months' residence, that they, too, must steep themselves in hot baths or else they catch cold. Here again is an important point, it seems to me, that without due regard to the physical conditions, the geographical conditions, no custom of any other country can be despised.

We have earthquakes in that long island. Somewhere it is said that we have three earthquakes in two days; therefore, seismology has developed most in Japan. We have a very able professor of seismology in our university; it is a very important thing for us to know exactly where the earth is shaking, and when its long shake will come. That explains the numerous catastrophes that we have—the tidal waves and earthquakes that you see so often in your newspapers; but that very fact gives beauty to the landscape; our scenery is beautiful, everybody says. I do not wish to boast too much of my own country; but there is no question whatever that Japan is one of the most beautiful countries in the world. I do not mean the people are beautiful, I do not think so; but nature is certainly beautiful; the color, the hazy, misty sky, the flowers and the eternal mountain, Fuji, 14,000 feet high. We have other mountains than Fuji, but that is the mountain; its graceful slope and its symmetrical shape are unique, perhaps, in the geography of the world. It is no wonder that so many think that there must be a god there, lodged on its summit. It looks so superbly grand that we naturally think that some beings, higher than human nature, must have their abode there; and you see in Japanese works of art and in our poetry Fuji painted and sung so often, in fact, without knowing Fuji you can hardly understand most of our art designs and some of the finest passages in our literature.

Closely connected with this volcanic character of the country is the type of our architecture. You say, "The Japanese live in little huts, low huts;" as though the higher the civilization, the higher the houses must go. Whatever may be the standard of civilization, our houses are very low, two stories; three-story houses are rare even in Tokio. Why? One reason, very simple, people are poorer than in this country. We are an old country, and I am glad that in old countries there are neither very rich nor very poor. That is a very good reason, but there is another, and that is the earthquake, the constant shaking, so the houses must be built low. Some of the more high-storied buildings, in order to resist the shock of the earthquake, must have thick walls; and those of the new Bank of Japan are 4 feet thick. When the walls are 4, or even 2 feet thick the building can withstand quite heavy shocks; but if a brick house has walls thinner than 2 feet, it is much safer to live in wooden houses. That, then, explains the form of our architecture, and I need not say that houses have so much to do with manners and also with morals.

Then the vegetation. It is generally considered that we are a very gay people, that we are always looking for flowers. Some English writer has said, "The Japanese are such good natured, overgrown people. They are children, they are like flowers that grow on the side of a volcano. The people are dancing and playing and singing and making merry; all the while beneath them the earth is shaking." But I must say that there is a very somber element in our character. People may look gay; I will explain later on, why. We try to hide our feelings. When we are sorrowful, we just try to repress our feelings and look and seem gay. It is considered very impolite to show our ruffled minds, so to speak, to other people. The instant we feel joy or sorrow, we try to repress it and not to show it. But there is a melancholy strain in the character of the people and there is a close connection between that phase of our character and physical nature. The sky and even the vegetation have a somber,

* Abridgment of an address delivered by Dr. Inazo Nitobe, of Sapporo, Japan, before the Friends' Institute Lyceum, of Philadelphia, and revised by the author, especially for the Scientific American Supplement.

softening effect on the people; the hazy atmosphere (certainly the sky of Japan is very different from that of Italy) exercising a subduing influence.

The gentleman who says of Japan, "All the trees grow crooked," saw pine trees. These trees grow in the north and in the south, in the gardens and in the forest everywhere, on the rocky precipices; and you cannot get rid of pines, and pines are with us the emblem of longevity; we speak of the pines living ten thousand years. There was a certain grove of pines in the southern part of Japan which was cut down for a railroad, and a poetess said, "If for the way" (that was the railway)—"if for the way thou fallest, I would not pray that thy years be ten thousand." The pines, the bamboos and the plum are three particular kinds of plants that we value so much for rhetorical figures. The bamboo is always green, green in a good sense, and though it is gentle and moves about as the wind will have it go, yet it will never succumb.

The average possession of our farmers is about three acres. On these few acres they raise three or four crops successively in one year. You can imagine how intensive our farming must be when I tell you that with a gross area of three or four times the size of Pennsylvania (one-twelfth only of the whole country being cultivated) we grow enough to feed 45,000,000 and export some, too.

Among our food staples are bamboo shoots (bamboo shoots are very nice, they taste like your asparagus), leeks, beans, carrots (cultivated), burdock and lotus roots. The root of the lotus is quite good eating. We even use chrysanthemums for table purposes; we make fritters, and we fry the tender leaves and also make beautiful salad from the petals.

The first flower of spring is a kind of plum, but a variety that you have not, which I think your botanists call Prunus umé. The tree is as large as your plum trees and blossoms while there is snow still lying on the ground and still falling. You very often see the trees covered with blossoms, and blossoms covered with snow. It is the first flower, and a very fragrant kind of flower, too.

After that comes the cherry, which we cultivate not for fruit; we are not provident enough to do that. We enjoy the flowers only, lasting only about three days; but it is a great season of merry-making when the cherry blossoms reach their height. We have the weeping cherry and the ordinary kind; and poems without number are written on the cherries; very often you see the branches of the smaller trees hung with strips of paper bearing little poems, people go there and get an inspiration or two and write it down.

Along the Sumida River, that flows through Tokio, one bank is planted for miles with cherries. We call cherries the national flower of Japan. We speak of cherries as representing best the spirit, the genius of the people. The wistaria was introduced to this country from Japan by Dr. Wistar: hence the name; only the clusters with us are about three feet long.

The lotus, another typical flower, is the sacred flower of the Buddhists, and a lovely one, too; they grow in the mud, and on that account it is taken as the type of a man or woman who, amid adverse circumstances, nevertheless keep up their virtue.

Some of our chrysanthemums have 250 flowers on one plant—the flowers, of course, of different sizes and colors.

The sedate and somber views of autumn are the kind of scenery the people really love. The cherry season lasts for three days, during which we enjoy merry-making; but it is in the autumn, when the colors of the trees change, and when the atmosphere becomes cooler, quieter, calmer, that some of the best sentiments of our poets have been expressed. Especially are maple trees connected with the melancholy bleating of the deer. Few scenes have been sung so often as the voice of the stag in the autumnal woods.

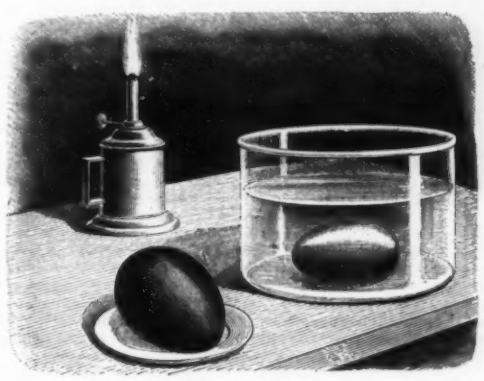
As to the historical influences, we are very likely a mixed race. We are often charged with being blind imitators—that the "Japanese are so apish they imitate anything;" and then, in corroboration of that statement, are various authors saying that one man took his bicycle to Japan and he broke a part of the bicycle and went to a Japanese store and had it mended. In three days he had his bicycle mended, but he had another; in three days the Japanese made another, very much like his own, so that he could not distinguish between the two; and stories of that kind circulate so much that from them you conclude though the Japanese must be very ingenious as imitators they have nothing original; and you will see in the course of my talk that we have borrowed a great deal and that we have not originated many things. I pride myself on being imitative. I think all great nations have been imitators. I do not think the Romans originated anything. It is usually said that the Romans originated law; but we know well enough that the fundamental principles of law came from the stoic philosophy; and the navy with which Rome extended her realm—was that not imitated from Carthage? And so with Greece: from Phenicia and Egypt art and literature—even philosophy—was brought; and so with the Jews: they imitated the Babylonians; so I am not at all ashamed to be called an imitative people—a very imitative people. The only people I know who can claim to be original—the only people who have borrowed nothing from others—are the Chinese; and you know what is going on with them.

Some scientific man has said there are two types of skull in our people, and another man found that there are two distinct types of physiognomy; while history hints there are at least two sources from which our ancestors came. I need not go into the details; it is enough at present to say that we are a mixed race, and that in a large measure will show why we are ready to take what is good in other people—that we do not stick to our own things, that we are not as original or as conservative as our neighbors, the Chinese. It is strange that, mixed as we are as a race, our feelings and our sentiments should in the course of time have become so uniform. That is a marked characteristic in Japanese sentiment and feeling, the love of country and loyalty to their ruler.

Our religion (whose origin is unknown), the Shinto religion (which is original with the Japanese), is a very simple kind of religion, consisting in nature and ancestor worship. It has no theology—nothing very profound; but it might interest the members of the Religious Society of Friends, in particular, that the Shinto theology starts with a proposition which is very much like the Friends', namely, that there is an Inner Light. Some of the things written by the Shinto believers would sound very much like a page from some Quaker literature. One author speaks of the God of Heaven coming down and dwelling in man and thus becoming his Light within. That is very Friendly. I can quote a number of passages like that. The practical effect of this teaching is that we pride ourselves in possessing in some degree this Inner Light that no other nation possesses. The ultra-patriotic writers in Japan used to say that in China there was Confucius, a very great teacher, in India there came Buddha to teach the people the right way; but to Japan heaven sent no prophet, and why? Because the Japanese are naturally good: they need no prophet! They have each and all the Inner Light within, teaching them right from wrong. Here I might say that nothing impressed me so much as the doctrine of the Inner Light as upheld by Friends, which came most naturally to my mind. Other systems of theology are, of course, profound: they are too profound, especially the doctrine of original sin is too profound for me to grasp; but this doctrine of the Inner Light appears so natural; and that may be the reason I might say why Friends should have (I mean as an organization) special religious interest in the progress of Japanese morals and in the march of Christianity in Japan.

The Shinto religion, believing in this Inner Light—making every body a temple of God even while he is in the flesh—making every man a god the instant he leaves the fleshly tabernacle, develops naturally the ancestor worship. We believe in the spirit of the ancestors still living and working among us; and I think we have good background for it. It is only by the dead that the race can continue. A French economist, Cheysson, has calculated that if there are three generations in a century, and each one of us has only two parents (and I don't think there is any exception to it), then each one of us who is living now has the blood of 20,000,000 souls, 20,000,000 men and women, who lived in the year 1000 A.D. Is it any wonder then that the dead are still living within us, that we feel their thoughts, are moved by their feelings? Lafcadio Hearn, in his charming book, "Glimpses of Familiar Japan," has enlarged upon the subject most beautifully.

So in the Shinto shrine you see no image—no idol; only a mirror hanging in the midst of the temple; and the idea is that if you look at the mirror and see your



THE SILVER EGG.

own image reflected there, you see God, because God is nowhere but in you. Look into the mirror, look at yourself, there is God. It is a simple, very simple, teaching; and the architecture is also very simple. That was Shintoism, the original religion of Japan; then came from China the ethical teaching of Confucius and Mencius, teaching the five relations of man: man in his relation as master and servant; then second, in his relation as father, or parent, and child; third, in the relation as husband and wife; fourth, in the relation of brother and brother, younger and elder; fifth, in the relation of friend, of man as friend to friend; and the last named ends the five relations. Later on came Buddhism, from India, with its elaborate ceremonies. Buddhism itself, pure and simple, is a beautiful religion; especially Buddhism as represented by the sect called the Zen is a very interesting and a splendid philosophy.

I spoke of Feudalism and its moral ideas as still active among us. It began in the eleventh century, at the time of the Norman conquest in English history, and it continued up to thirty years ago, when it was abolished as an institution. But what moves Japan at present is still the chivalry, the ethical ideas of Feudalism, which is best typified by a castle and a moat on the other side of it.

The wearing of swords was forbidden about twenty-five years ago, and the castles are now in most places razed to the ground, and so you see very few signs of Feudalism.

So many people speak of the Japanese as being polite. Politeness is a legacy of chivalry. Unless you know what chivalry meant, you cannot explain why Japanese people should be polite. I have heard an American say, "They bow so low in Japan, they are so slavish." I said, "Well, I think your hand-shaking is more slavish;" and he asked, "Why?" The only explanation I found as the reason for the begining of hand-shaking was in Spencer's "Sociology," where he says shaking hands came from kissing hands. When A and B met, A wanted to kiss B's hand and lifted it up, and B said, "Oh, no," and pulled down his hand and tried to lift A's hand up, and so the shaking of hands began. The shaking of hands is as much, perhaps more, slavish than to bow down.

Our homes are bare: simplicity, as I said, has been our characteristic, in theology and in our thoughts. Our philosophers' ideas are very simple; our religious teachings are simple; and so are our homes. I have seen so many so-called Japanese apartments in this country, and I have seen so many Japanese things—bric-a-brac, fans and what not—in them; but in real Japanese homes you don't see them. The vases and the little bric-a-brac are put there in the little closet, and there is visible only one little image for ornament, or one little flower vase and a picture; and the walls are bare. You do not see pictures covering the four walls. When people hear that the Japanese sleep on the floor, they think we just lie down on the hard, dirty floor to sleep. No; the floor is covered with mats, soft like your gymnasium mats, so they can squat down this way and not feel it. If we had to sit down this way on a marble floor, of course, then you might call us "topsy-turvy;" and so the Japanese anatomy must be a little different.

A brief forecast as to the future of our manners and morals. It has been predicted (and the predictions have been corroborated by the events of the last half-century) that the moral system of feudal Japan, like its castles and its armories, will crumble into dust and that new ethics will rise to take its place; that the new system of morals will, like the phenix, rise to lift older Japan on her path of progress. I believe these predictions will be fulfilled; but it is necessary to remember that the phenix never rises except from its own ashes, and that the moral salvation of Japan will come only from the Japanese. The kingdom of God is within you; it will not come rolling down the mountains, however lofty; nor will it come sailing across the oceans, however wide; but, at present, chivalry being partly on the decline, new systems of morals are coming to take its place, and among them may be mentioned utilitarianism and materialism, and then also Christianity. I am sure that just now and for some years to come, Christianity and materialism will divide their sway and that lesser systems of morals (such as the feudal system of morals) will have to step aside; but the question is, On which side will chivalry enlist itself? Having no claim to defend, it can afford to disappear as an entity; but I am sure that it will never be entirely extinct. We speak of the stoics being dead, but when we say so, we mean that the stoic philosophy as a system is no longer considered to be tenable; but wherever there is a great character who strives to erect himself above himself by his own exertions, there is the teaching of Zeno. But mark! so it will be with the old ethical system of Japan, amid the many changes that are going on: whatever good there is in Japanese character and in our manners and morals, that is due chiefly to the effect of the teaching of Bushidō, of chivalry, of feudal ethics; and I believe that this influence will never die in Japan: Christianity will, I hope, and I believe, conquer the world; I believe that some day Christianity will be the prevailing religion of the Japanese; but, even then, the spirit of chivalry—of Bushidō—will never entirely die. Ages after, when its literature will have been forgotten, and when even its very name is forgotten, its odors (I say odors, because chivalry is so often compared with the sweet-smelling cherry-blossoms)—its odors will come floating in the air, "as from some far-off unseen hill the wayside gaze beyond." Then, in the beautiful language of the Quaker poet,

> "The traveler owns the grateful sense
> Of sweetness near—he knows not whence;
> And, pausing, takes, with forehead bare,
> The benediction of the air."

And such a time is fast coming: things will change; and the spirit of the Japanese, as educated in the tenets of knighthood and chivalry, will never die; and without understanding that, you have no key to the solution of the morals or of the manners of the Japanese.

THE SILVER EGG.

A SILVER spoon held over a tallow-candle soon receives a coating of black. If this same spoon with its coating of lamp-black be plunged into a vessel of water, a very curious thing will happen. The spoon will no longer appear black, but metallic. When it is removed from the water, however, we find, contrary to our supposition, that the coating of lamp-black has not been washed away. The phenomenon can be readily explained. The water cannot penetrate the layer of the black, therefore merely adapts itself to the shape of the spoon without coming in contact with the metal, and reflects light as perfectly as a mirror.

The experiment in a modified form can also be performed in the following manner. An egg is held over a candle or preferably a smoky petroleum-lamp until it is completely coated with lamp-black. When placed in a vessel of water the egg will have a metallic sheen, and will appear to have been silvered over. When removed from the water, however, it immediately becomes black again.

DENTAL PASTES.

CHERRY TOOTH PASTE.

Clarified honey	225	grammes.
Precipitated lime	225	"
Powdered orris root	225	"
Rosewater	28	"
Clove oil, nutmeg oil and geranium oil, each	30	drops.
A little sirup.		

The oils are well worked together with the orris-root powder; passed through a sieve and made into a paste of suitable consistency with the honey and finally the sirup.

CHINESE TOOTH PASTE.

Finely powdered pumice stone	325	grammes.
Starch	85	"
Peppermint oil	40	drops.
Carmine	1	gramme.

Mix and pass through a sieve.

MOUTH SOAP.

Finest white soap	225	grammes.
Powdered lime	225	"
Orris root	225	"
White sugar	112	"
Rose water	112	"
Clove oil	60	drops.
Essence of peppermint	7	grammes.

Dissolve the cut-up soap in water, add the rose water, grind the oils with the sugar, the orris root and the lime and mix thoroughly with the other ingredients.—Journal de la Parfumerie et Savonnerie Franç.

TRADE NOTES AND RECEIPTS.

To Render Light Fabrics Fire-proof they are saturated with a solution of pure ammonium phosphate, 8 parts; ammonium carbonate, 2·5 parts; boracic acid, 3 parts; borax, 2 parts; and dextrin, 0·4 part in 100 parts of water. This process is probably very suitable for the production of incombustible cotton-wool for the Christmas tree.—Pharmaceutische Post.

Production of Gold and Platinum in the Ural District.—In 1899 there were produced in the Ural District 651 pud of gold, valued at 750,000 rubles, as against 611 pud in 1898. The production of platinum in 1899 amounted to 380 pud, as against 364 pud in the preceding year. One-third of the platina production is from the platina mines of Count Shewaloff. The mines of Prince de Donato furnished 70 pud, while a foreign company won 100 to 120 pud of platina. Owing to the rising prices, the exploitation of the platinum mines will increase.—Journal der Goldschmiedekunst.

Leather Oil.—A leather oil which renders the shoes durable, soft, and waterproof is described as follows: The following mixture is prepared by melting together, over the fire, in an enameled iron vessel: Vaseline, 400 grammes; ceresine, 100 grammes; the melted mass, which is used as a grease, is filled in wooden boxes or tin cans.

Another leather grease is the following: The oleic acid of the stearine factories is heated with strong alcohol and sulphuric acid. Take 16 kilogrammes of oleic acid, 2 kilogrammes of alcohol (90 per cent.) and 1 kilogramme of concentrated sulphuric acid. The oleic-acid ether formed separates as a thin brownish oil. It is liberated from free sulphuric acid and the alcohol in excess by agitation with warm water and allowing to settle. This oleic-acid ether is mixed with the same weight of fish oil and 4 to 8 grammes of nitrobenzol is added per kilogramme to disguise the odor.—Illustrirte Schumacher Zeitung.

Production of Mineral Oil for Spinning Purposes.—It is well known that mineral oil is excellently adapted for spinning wool, as far as the spinning is concerned. But, on the other hand, the yarns and cloths can only be washed clean with considerable expenditure of soap, soda and time, while the color is sometimes impaired, so that the application is not practicable, although very desirable, considering the low price of mineral oil as compared with that of the glycerides and fatty acids.

In order to be able to wash out the mineral oil or render it "saponifiable," according to spinning parlance, the following process is recommended: Heat the mineral oil with 5 to 10 per cent. of oleine, add the proper amount of alcoholic lye and continue heating until the solvent (water alcohol) evaporates. A practical way is to introduce an aqueous lye at 110° C. to 120° C. in small portions and to heat until the froth disappears. One may also commence or stop, however, with other temperatures, without the result being altered, it being necessary for clearness only to evaporate all the water. In the same manner, more oleine may be added as desired if the admixture of lye is kept within those limits that not too much soap is formed or the mineral oil becomes too thick. After the cooling a uniform but gelatinous mass results. Same is made liquid by mechanical treatment, during or after the cooling, squeezing through fine sieves being the best method. Hence, soap is so finely and intimately distributed in the mineral oil that the finest particles of oil are isolated by soap, as it were.

When a quantity of oil is stirred into the water so intimately an emulsion results that the different parts cannot be distinguished. The same process takes place in washing, the soap contained in the oil swelling between the fibers and the oil particles upon mixture with water, isolating the oil and lifting it off from the fiber.

In the same manner lubricating oils may be produced which are so viscous with little interior friction that they run off very little or not at all, and do not spread over surfaces or rise up, hence are both economical and cleanly.—Seifensieder Zeitung.

New Incandescent Mantles.—The mantles produced according to the following process are claimed to excel all former ones in strength and elasticity, or resistance to pressure, knocks and draught, while the luminous power is the largest possible.

The new process, invented and patented by George Kohl and Ritter von Theumar, of Vienna, differs from the customary modes of manufacture in that in the second impregnating fluid a mixture of the nitrates of uranium, chromium and platinum is substituted for the cerium or cerium nitrate.

For the first impregnation a solution of—

Zinc nitrate	2	grammes.
Stannic nitrate	1·2	"
Bismuth nitrate	1	"
Borax	1	"
Calcium nitrate	2	"

in 1 kilogramme of water is employed.

After the drying of the impregnated mantles, which is best conducted at a gradually rising temperature, they are saturated by quick immersion into a solution of—

Thorium nitrate	400·00	grammes.
Barium nitrate	0·04	"
Strontium nitrate	3·02	"
Indium nitrate	0·12	"
Gallium nitrate	0·04	"
Samarium nitrate	0·24	"
Uranium nitrate	0·30	"
Chromium nitrate	0·12	"
Platinum nitrate	0·01	"

in 1 kilogramme of water.

The gauze is now freed from an excess of the impregnating agent by means of a wringer and dried.

The fastening of the hangers, the burning off, etc., are conducted in the manner generally in use.

The mantles in a cold state possess a faintly yellow coloring, due to the uranium and chromium, which is not at all disturbing. They are very restrictive to knocks and concussions. The nets are woven more closely at the end where they are suspended so that the customary re-edging becomes unnecessary. — Nueste Erfindungen und Erfahrungen.

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